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RESULTS OF PROVIDING A LIBERALLY ADEQUATE DIET TO CHILDREN IN AN INSTITUTION

I. ACCEPTANCE OF FOODS AND CHANGES IN THE ADEQUACY OF DIETS CONSUMED

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THIS report presents the results of providing a generously adequate diet to children in an institution for the period of a year. Various workers have reported the beneficial results of adding a single food supplement to the diets of children who were supposedly already being reasonably well fed. Some have added milk,[1, 2, 3, 5] other fruits,[4, 5] wheat germ,[6] egg,[7] or other foods. In all cases the supplemented group has shown improvement over the nonsupplemented one. The criterion most commonly used has been that of growth. In each case it has been concluded that the original diet had been lacking in one or more constituents provided by the added food. This is in accordance with the theory advanced by Orr[8] that an adequate diet is one which is not susceptible of improvement as judged by growth and other signs of development. Two previous studies of this type have been made in this laboratory. In one[9, 10, 11] an additional pint of milk was given daily for a full year to children in an institution who were already receiving a scant pint. In the other, from two to three bananas were provided daily for nine months to a group of boys whose diets, though better than the average, appeared to need some supplementation in vitamin C and in calories.[11] In both cases the results were measured on carefully matched groups by growth in height and weight, rate of ossification of carpal bones, rate of advance in dental caries, and in the second study also by vitamin C in the blood plasma, and the Franzen indices of nutrition. By all criteria used, the supplemented group in each case fared better than the nonsupplemented one. Even this group, however, did not measure up to desired standards. This was especially true of the first study in which the original diet had been less satisfactory. It was concluded that in this institution the diet was lacking not only in constituents provided by milk but that it was also poor in other respects, especially in vitamin C, thiamine, and vitamin A. In the other study, the supplemented diet appeared to be more nearly adequate.

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The results obtained in these studies, as well as others, by a single food supplement, indicated the desirability of testing the effect of fortifying the diets of children with all foods needed to make them fully meet the amounts recommended in the usual dietary patterns. The present study was an attempt to carry out such a project. Owing to the fact that it was carried out under wartime conditions, some procedures originally planned had to be omitted and other features were not all that were desired. It does, however, indicate the pattern for such a study and the type of results that might be expected if conducted under more ideal conditions.

The Institution and Subjects.—The institution selected was a boarding school for children. Part of the children lived in the institution (designated hereafter as boarders), others came in for the day and were present for two or three meals five or six days of the week (designated as "day" children). It would have been preferable to have a home where all children were full-time boarders. Owing to wartime restrictions of travel it was necessary to select one near the laboratory in order to be able to carry out the various tests. The one chosen was only about two miles from the University and had the further advantage that the director welcomed the project wholeheartedly and promised her full support.

The subjects ranged in age from 2 to 14 years, but the majority were in the early school age group of 6 to 10 years. All were girls with the exception of a few boys in the first grade kindergarten, and nursery groups. The number of children used in the final analyses was 152, but a considerably larger number were present for short periods and participated to some extent in the program.

The Supplements.—Preliminary observations showed that the diet was about the average found in children's institutions. It contained some of all the essential foods, but in most cases not in the full amounts usually recommended. It provided approximately a pint of milk per child; a small serving each of vegetable, meat, and fruit; a small pat of butter once a day; an egg about once a week; and plenty of cereals and white bread. The food was well cooked and palatable and was served and eaten under conditions favorable to its consumption. The following tabulation shows the standard dietary pattern, the diet of the institution, and the supplements added or changes made to bring the diet up to the pattern (Table I). It is recognized that this pattern does not represent the only way of attaining an adequate diet. It is, however, one usually well suited to American dietary customs and was therefore used in this study.

The foods provided to bring about the desired improvement were: (1) one pint or more of homogenized vitamin D milk per child daily; (2) five eggs per week per child; (3) one ounce of cheese three times per week; (4) one ounce of butter per day; (5) a whole-grain breakfast cereal each morning; (6) pineapple juice ad libitum (after an initial period on 4 to 8 ounces); and (7) a 5-ounce serving of ice cream twice per week. The director agreed to continue purchasing the same quantities of essential foods as previously, so that these additions brought the quantities used liberally up to or above those designated in the dietary pattern. By working with the director and cook, improvements were also effected in the selection and preparation of foods. All bread, whether

TABLE I. THE DIET OF THE INSTITUTION, COMPARED WITH THE STANDARD DIETARY PATTERN

FOOD	ADVISED PATTERN	INSTITUTION PROVIDED	ADDITIONS OR CHANGES
Milk	1½ pints to 1 quart	One pint, approximately	One pint
Eggs	One per day	One per week	5 per week
Meat	One serving	One small serving	
Other protein	Another serving of same or other	Beans occasionally	Beans, peanut butter, cheese or more meat or egg daily
Butter	3 or more pats per day	1 small pat per day	1 ounce per day
Potato	One or more servings	Usually one; mostly mashed	One daily; mostly cooked in skins
Vegetable	One or more servings	One or more	Cooked to conserve nutrients
Fruit	One good antiscorbutic One or more additional servings	Small serving of some fruit; occasionally ½ small orange or other raw fruit	Pineapple juice ad libitum
Cereals and bread	All whole-grain or enriched	White bread; breakfast cereal daily, sometimes whole grain	All whole-grain or enriched

baked or purchased, was whole grain or enriched; potatoes were most often baked or boiled in their skins; only whole-grain or restored breakfast cereals were used; and the use of candy was discontinued. A nutritionist lived in the institution to help in planning the diets, to keep records of the foods used, and to assist in all aspects of the study.

An educational program was also carried out with the children and parents. This was done with two objectives. As has been indicated, part of the children were day students who were present for five or six days, for one or two meals. Most of the boarders, moreover, went home for a half or full day at the week end. If the program was to be fully effective it was essential that it be continued during the time spent outside the school. This end could be attained only by education and motivation of children and parents. Moreover, an understanding of the program in the school was essential to its full acceptance by the children and staff. To effect these purposes, simple nutrition lessons or demonstrations were given in each classroom once a week by the project supervisor, and materials were also provided for use by the teacher. Three times during the year a parents' meeting was held to explain the nature and purpose of the program and the service that was being rendered their children and to solicit their cooperation in providing the same type of meals during the week ends when the children were away from the home. The cooperation thus obtained was surprisingly good, and it is believed that in the main the week-end diets conformed fairly well to those of the school.

The results of the program were evaluated by a variety of means: (1) the extent of acceptance of the foods by the children; (2) the changes in the diets actually consumed as a result of the supplementation; (3) the growth in height and weight before, during, and after the supplementation; and (4) changes in the nutritional status for thiamine and riboflavin, vitamin C, vitamin A, protein, and iron, as judged by appropriate studies of blood or urinary excretions, or both. The procedure and results of each of these will be presented in the order listed.

ACCEPTANCE OF SUPPLEMENTARY FOODS BY CHILDREN

It is one thing to provide the desired foods, another to insure that they are eaten. In the present study it was considered desirable to know the extent to which children did accept the supplementary foods, and in what amounts. Daily records were therefore kept of each child's consumption. The children ate at tables seating from five to ten, each with a teacher or matron in charge. Blanks were provided on which the person in charge could check the number of servings of each food each child ate. The foods were served in standard portions, and the records of intakes are thus roughly quantitative. Since the number of children present at different meals varied considerably, the acceptance of foods has been evaluated in terms of child opportunities; that is, the number of times a child had an opportunity to take the food and the percentage of times specified amounts were taken.

Milk.—It was planned that each child would have an 8-ounce glass of milk at each meal, and glasses were provided which held this amount. In addition, pitchers of milk were put on the table and children were allowed as much more as they requested.

Table II shows that the acceptance of milk was remarkably good. Out of 52,662 opportunities, in only 0.6 per cent did a child take none, and in 3.5 per cent but one-half cup. The expected quota of one cup was consumed 64.2 per cent of the times, but in 31.7 per cent it was more than this. As would be expected, the oldest group consumed the most. In only 0.2 per cent of the times was none taken by this group, and in only 1.1 per cent as little as one-half cup. In 40.6 per cent of the times it was available more than a cup was consumed, and in 7.4 per cent it amounted to over two cups. This is testimony to the fact that children like milk and will drink it if it is available, and if conditions are psychologically favorable to its acceptance.

Butter.—Butter was also well liked. Out of 41,852 opportunities, in only 5.1 per cent was none taken. The most common amount was one pat (8 Gm.) which was eaten 55.2 per cent of the times it was available, but in 16.7 per cent it was more than this. In this case the consumption was highest in the second age group. In only 3.7 per cent of times was none taken, and in 13.5 per cent as little as one-half pat. Two-thirds of the times one pat was eaten and in 17.7 per cent more than this.

Actually, the liking for butter was probably greater than this record indicates. The adults in charge had not been accustomed to providing butter on bread when such foods as jam, cheese, or peanut butter were served, and it was difficult to convince them that it was allowable to have both. Some of the failures to eat butter, therefore, were doubtless due to the fact that it was not offered, especially among the younger children. A striking illustration of their liking for butter was given on a day when, after a few days without it due to problems of rationing, the children saw it on the table as they came into the dining room. Smiles and exclamations passed along the line, and the consumption of bread and butter returned to previous levels.

Eggs.—An egg a day for each child was the accepted plan, but more were allowed, when desired, if they were available. The eggs were nearly always

TABLE II. ACCEPTANCE OF SUPPLEMENTARY FOODS SERVED AT MEALS

FOOD AND AMOUNT	TOTAL		GROUP I		GROUP II		GROUP III		MISCELLANEOUS	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Milk (8 oz. serving)	52,662	100.0	26,824	100.0	10,290	100.0	13,905	100.0	1,643	100.0
Opportunities										
Less than 1 cup	2,174	4.1	1,149	4.3	812	7.9	177	1.3	36	2.2
None	326	0.6	251	0.9	42	0.4	25	0.2	8	0.5
One-half cup	1,848	3.5	898	3.4	770	7.5	152	1.1	28	1.7
One cup	33,795	64.2	18,102	67.5	6,578	64.9	8,082	58.1	1,023	62.3
More than 1 cup	16,693	31.7	7,573	28.2	2,900	28.1	5,646	40.6	574	35.0
Butter (8 Gm.)	41,852	100.0	20,482	100.0	8,512	100.0	11,586	100.0	1,272	100.0
Opportunities										
None	2,137	5.1	811	4.0	317	3.7	1,005	8.7	4	0.2
0.5	9,635	23.0	6,971	34.0	1,151	13.5	1,315	11.3	198	15.6
One	23,023	55.2	10,386	50.7	5,542	65.1	6,306	54.4	839	65.9
More than one	7,007	16.7	2,314	11.3	1,502	17.7	2,960	25.6	231	18.3
Eggs (One)	15,074	100.0	6,716	100.0	3,224	100.0	4,574	100.0	560	100.0
Opportunities										
None	981	6.5	596	8.8	154	4.7	213	4.6	18	3.2
One-half	1,771	11.7	999	15.0	441	13.7	269	5.9	62	11.1
One	11,095	73.6	4,749	70.7	2,364	73.4	3,535	77.3	447	79.8
More than one	1,227	8.2	372	5.5	265	8.2	557	12.2	33	5.9
Cheese (1 oz.)	7,888	100.0	4,035	100.0	1,596	100.0	2,096	100.0	161	100.0
Opportunities										
None	324	4.1	162	4.0	63	4.0	93	4.4	6	3.6
One-half	1,647	20.9	1,060	26.3	299	18.7	247	11.8	41	25.6
One	4,919	62.3	2,445	60.6	1,085	68.0	1,286	61.3	103	64.0
More than one	998	12.7	368	9.1	149	9.3	470	22.5	11	6.8
Cereal (½ to ⅓ cup)	13,335	100.0	5,873	100.0	2,769	100.0	4,285	100.0	418	100.0
Opportunities										
None	190	1.4	128	2.2	24	0.9	26	0.6	12	2.8
One-half	442	3.3	103	1.8	41	1.5	267	6.2	31	7.5
One	10,966	82.3	4,994	85.8	2,249	81.5	3,438	80.2	285	68.2
More than one	1,737	13.0	648	11.0	445	16.1	554	12.9	90	21.5
Ice Cream (5 oz.)	11,245	100.0	5,501	100.0	2,417	100.0	3,002	100.0	285	100.0
Opportunities										
None	466	4.1	267	4.8	107	4.4	81	2.7	11	4.0
One-half	169	1.5	133	2.5	28	1.2	8	0.2	--	--
One	10,188	90.6	4,990	90.7	2,136	88.4	2,796	91.5	266	93.0
More than one	434	3.8	113	2.0	146	6.0	167	5.5	8	3.0

served for breakfast, cooked in a variety of ways, and were soon accepted as a necessary component of this meal. They were also sometimes served at the noon meal as egg sandwich, or in other form.

Out of 15,074 opportunities, the standard of one egg per day was the amount accepted in 73.6 per cent, and in 8.2 per cent it was more than this. In 11.7 per cent only one-half egg was eaten, and in 6.5 per cent none. The lesser consumption was contributed largely by the youngest group, who took only one-half egg (15 per cent) or none (8.8 per cent) in one-fourth of the times it was available. The oldest group, however, took one egg or more in 89.5 per cent of times offered, and none in only 4.6 per cent. The lower acceptance of eggs, especially by the youngest group, was in part due to the fact that eggs were to some extent in competition with cereals, which had long been an established part of breakfast. When these were eaten in customary amounts the appetite was

often satisfied before the egg was offered. In spite of this, however, the acceptance of eggs by the group as a whole was gratifyingly high.

Cereals.—Cereal for breakfast had been the usual rule in the home. The only change made, therefore, was that the cereal was always whole grain. Usually this was a cooked cereal—rolled oats, cracked or rolled wheat—but occasionally for variety a whole-grain ready prepared one was used. Since the children were already accustomed to cereal for breakfast, its acceptance was high. Out of 13,335 child breakfasts, in only 1.4 per cent was no cereal eaten, and in 3.3 per cent only half a serving. One serving was taken in 82.3 per cent of the times and more than this in 13 per cent. Again it is the middle age group that had the highest degree of acceptance; 97.6 per cent took one serving or more and only 0.9 per cent none. Comparisons are less justified in this instance, however, as servings were less well standardized than for other foods. It is evident in any case that the children liked and ate whole-grain cereals unusually well.

Cheese.—Cheese was served at the noon meal at least three times a week. For the two older groups it was cut into 1-ounce slices; in the youngest group, in ½-ounce ones. These were put on the table to be used by the children as they wished. This method was tried at the outset instead of using it in made dishes in order to simplify record keeping. The plan went so well that it was continued. Occasionally when extra cheese was available it was also used in sandwiches or in made dishes. The children made sandwiches of their cheese or ate it along with their potatoes or bread, or just by itself. It was often in competition with other food, such as peanut butter sandwiches, but even so its acceptance was good. Out of 7,888 opportunities, in 75 per cent one 1-ounce serving or more was taken, in 20.9 per cent ½-ounce, and in 4.1 per cent none. The oldest group took a full 1-ounce serving or more in 83.8 per cent of times, and in 22.5 per cent it was 1½ to 2 ounces.

This record indicates that cheese finds ready acceptance as a regular part of children's meals, and that it may be served as such, without the necessity of combining it in other foods.

Ice Cream.—Ice cream was provided in amounts planned to give each child one 5-ounce serving at lunch twice a week. Usually there was enough to allow some second servings and also to serve it at the evening meal for the smaller group of boarders who lived in the home. As might be expected, ice cream was well liked. Out of 11,245 child opportunities, in 94.4 per cent one or more servings were eaten, and in only 4.1 per cent none. The youngest children, as would be expected, failed most often to take their ice cream (4.8 per cent), and fewer had second helpings (2.0 per cent). This is due in part to the fact that small children do not like very cold or very hot food, and in part to the fact that the ice cream came at the end of the meal when they sometimes found they could not eat any more, much as they would like to. In the oldest group only 2.7 per cent ate none and 5.5 per cent had more than one serving.

Regardless of the amount eaten, ice cream was psychologically a great boon. Even those who were not always able to eat it looked forward to the days when ice cream would be served. It thus helped to lend "tone" to the project as nothing else could.

Pineapple Juice.—Pineapple juice was served, not at meals, but at the ten o'clock recess period, as a between-meal refreshment. This was done as the most feasible way of insuring that it was taken in addition to the fruit already being used rather than possibly replacing it. Pitchers of juice were taken to the schoolrooms as the children came in from recess and served to them in paper cups. Daily records were kept of amounts consumed. At first only one 4-ounce cup was served, but soon the quota was stepped up to two cups (8 ounces). In both periods more was allowed if any was left in the pitchers. Finally, the amount provided was increased and the children allowed to drink it ad libitum. Table III shows the total consumption during all periods by age groups.

TABLE III. NUMBER AND PERCENTAGE OF TIMES CHILDREN CONSUMED SPECIFIC AMOUNTS OF PINEAPPLE JUICE

NUMBER OF CUPS (4 OZ.)	TOTAL		GROUP I		GROUP II		GROUP III	
	NO.	%	NO.	%	NO.	%	NO.	%
All Periods								
Opportunities	25,400	100.0	12,502	100.0	6,976	100.0	5,922	100.0
None	261	1.0	123	0.9	88	1.3	50	0.8
One-half (2 oz.)	28	0.1	12	0.1	15	0.2	1	—
One (4 oz.)	6,665	26.2	4,466	35.7	1,350	19.4	849	14.3
Two (8 oz.)	8,792	34.6	5,041	40.3	2,612	37.4	1,139	19.1
Three (12 oz.)	5,460	21.5	1,800	14.4	1,838	26.3	1,822	30.9
Four (16 oz.)	2,702	10.6	758	6.1	780	11.2	1,164	19.5
Five or more (20 oz.)	1,492	5.8	302	2.4	293	4.2	897	15.2
Ad Libitum Period Only								
Opportunities	11,138	100.0	3,672	100.0	4,251	100.0	3,215	100.0
None	189	1.7	93	2.5	52	1.2	44	1.3
One-half (2 oz.)	13	0.1	2	—	10	0.2	1	—
One (4 oz.)	1,427	12.8	678	18.5	629	12.5	220	6.8
Two (8 oz.)	2,602	23.4	1,042	28.3	1,133	26.6	427	13.3
Three (12 oz.)	3,360	30.1	1,003	27.3	1,547	36.4	810	25.2
Four (16 oz.)	2,125	19.0	573	15.6	689	16.2	863	26.9
Five or more (20 oz.)	1,422	12.8	281	7.7	291	6.8	850	26.4

This record leaves no doubt as to the liking of pineapple juice by these children. Out of 25,400 child opportunities, in only 1.0 per cent was none taken, and in only 0.1 per cent was one-half cup accepted. In 26.2 per cent of times the consumption was one or one and one-half cups (4 to 6 ounces), in 34.6 per cent it was two to two and one-half cups (8 to 10 ounces), and in 37.9 per cent it was three to five cups (12 to 20 ounces). In the oldest group only 0.8 per cent took none and 84.7 per cent drank from two to five cups (8 to 20 ounces). In the ad libitum period the consumption was maintained at the higher levels. In 85.3 per cent of times two cups (8 ounces) or more were taken; the percentages consuming this amount were 78.9, 86.1, and 91.8 for the three age groups, respectively.

The director had stated at the beginning of the study that the children were especially fond of pineapple juice, and the ready acceptance at the outset, therefore, was not surprising. It was expected that after the initial novelty wore off there might be a decline in the amount taken. Instead, however, the consumption was maintained at a high level until the end of the year. The belief of the director in the children's liking for pineapple juice was thus confirmed by their high degree of acceptance of it during the year.

This record of the acceptance of the supplementary foods by these children is in itself highly significant. The claim is often made that children cannot or will not eat the basic foods in the amounts advised in recommended dietary patterns or that if they do consume the full amount of one it will automatically reduce the amount of another. This record shows that in 94 to 99 per cent of the times offered, all these foods were accepted, usually in amounts designated in the dietary pattern, and in many instances in larger amounts. It is not claimed that the full quantities of some foods which were taken were essential, but it is of interest to know that the dietary plan is a practical one so far as its acceptance by children is concerned.

THE DIETS OF THE CHILDREN AS AFFECTED BY THE SUPPLEMENT

In order to know more precisely how the supplementation affected the intake of various dietary essentials, a dietary study was made at the beginning and end for all children living in the institution and having all three meals there. A worker was stationed at each table to weigh all food eaten by each individual child. This process was facilitated by procedures which have previously been described.[12] All food eaten between meals was similarly recorded. Samples of all prepared dishes were taken to the laboratory and their calorie and protein values determined by the oxycalorimeter and Kjeldahl procedures.[13] Values for unmixed foods, such as butter, milk, and eggs, were calculated using tables of average composition. From the values so obtained the calorie and protein intake of each individual was computed.

Since it was desired especially to know the changes in the intakes of thiamine, riboflavin, and vitamin C due to supplementation, determinations of these constituents were made for all mixed dishes and for all other foods which were used in significant amounts, such as milk, potatoes, and bread. A few unmixed, or less used foods, were calculated from published values. The samples were collected by the nutritionist who lived in the home and taken promptly to the laboratory. Thiamine was determined by the micro-yeast fermentation method of Atkins, Schultz, and Frey,[14] riboflavin by the microbiological assay described by Snell and Strong[15] and modified by Strong and Carpenter.[16] Ascorbic acid was determined by the method of Bessey.[17]

Analyses were not made for calcium or vitamin A, but these were calculated from tables of average composition. Since the foods contributing them in largest amounts—milk, eggs, butter, green vegetables—were usually served unmixed, this calculation is probably sufficiently accurate for the purposes of this study.

The intakes of the various dietary essentials for the twenty-five boarders who were present during both the beginning and final studies are given in Table IV and Chart 1, in averages for four age groups. The Recommended Allowances of the Food and Nutrition Board of the National Research Council are also included for comparison. Though computed for only twenty-five children, these diets are representative of those consumed by the entire group during the time they were in the school.

It is readily seen in Chart 1 that the initial intakes of all nutrients for all age groups were below the recommended allowances for all factors except vitamin A. The groups as a whole averaged 30 per cent below the allowances in calories, 20 per cent in protein, and 31 per cent in calcium. In each case the deviation was greatest in the 13- to 15-year-old group, amounting to 39 per cent in calories, 27 per cent in protein, and 44 per cent in calcium. In the case of thiamine and vitamin C the average intakes for the group failed by 51 and 43

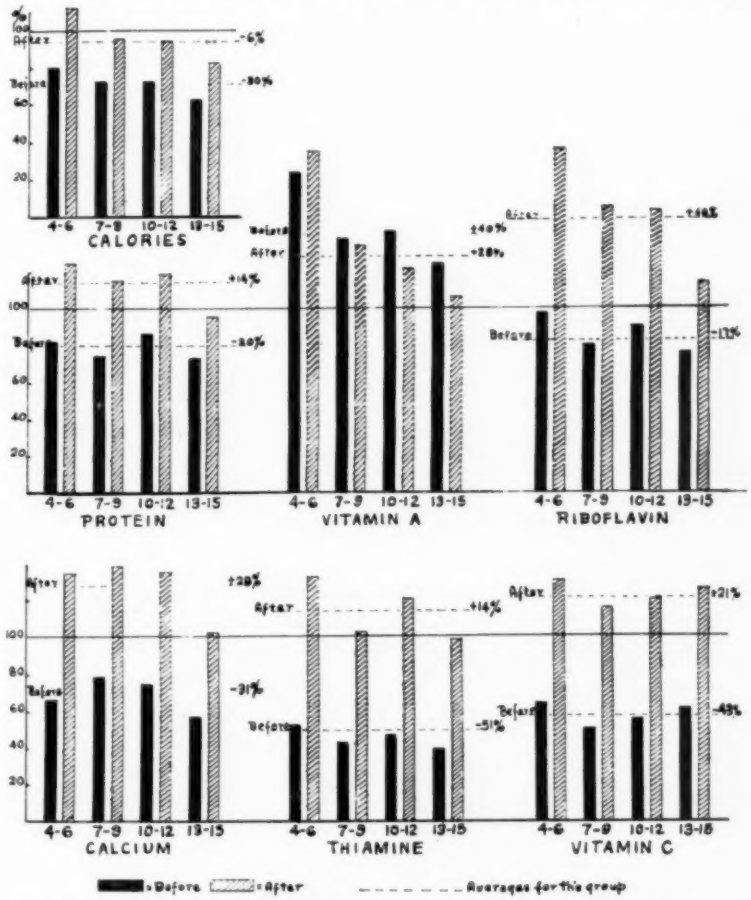

Chart 1.—Intake of nutrients on initial and supplemental diets, as compared with recommended dietary allowances.

per cent, respectively, to meet the recommended amounts. For riboflavin, the intakes more closely approached the allowances, the group as a whole averaging only 17 per cent below them. In the oldest group, however, the deficit amounted to 24 per cent. The intakes of vitamin A exceeded the allowances at all ages by amounts ranging from 73 per cent in the youngest group to 24 per cent in

the oldest one, and averaging 40 per cent for the entire group. Much of the vitamin A value came from carotene, but the pint of milk and the small amount of butter and eggs used contributed some as vitamin A.

On the supplemented diet, as may be observed in Chart 1, there was a marked rise in the intake of all dietary constituents, except vitamin A. These increases amounted to 33 and 43 per cent, respectively, for calories and protein;

TABLE IV. INTAKE OF NUTRIENTS FOR VARIOUS AGE GROUPS AS AFFECTED BY THE IMPROVED DIET

DIETARY CONSTITUENT	AGE GROUPS				ALL
	4 TO 6	7 TO 9	10 TO 12	13 TO 15	
Number	5	6	9	5	25
Calories					Weighted average
Before	1,280	1,447	1,803	1,700	1,592
After	1,790	1,905	2,358	2,296	2,123
Per cent increase	40	37	30	28	33
N. R. C. Allowance	1,600	2,000	2,500	2,800	2,260
Per cent deviation before	-20	-28	-28	-39	-30
Per cent deviation after	+12	- 5	- 6	-18	- 6
Protein					
Before, Gm.	41	45	60	58	52
After, Gm.	62	69	82	78	74
Per cent increase	51	53	37	34	43
N. R. C. Allowance	50	60	70	80	65
Per cent deviation before	-18	-25	-14	-27	-20
Per cent deviation after	+24	+15	+17	- 3	+14
Calcium					
Before	657	776	883	727	781
After	1,344	1,375	1,625	1,328	1,449
Per cent increase	105	77	84	83	85
N. R. C. Allowance	1,000	1,000	1,200	1,300	1,132
Per cent deviation before	-34	-22	-26	-44	-31
Per cent deviation after	+34	+38	+35	+ 2	+28
Vitamin A					
Before	4,336	4,782	6,376	6,190	5,548
After	4,595	4,658	5,455	5,322	5,065
Per cent increase	6	- 3	-14	-12	- 9
N. R. C. Allowance	2,500	3,500	4,800	5,000	3,960
Per cent deviation before	+73	+37	+41	+24	+40
Per cent deviation after	+84	+33	+21	+ 6	+28
Thiamine					
Before	441	462	623	560	543
After	1,051	1,124	1,434	1,378	1,272
Per cent increase	138	143	130	146	135
N. R. C. Allowance	800	1,000	1,200	1,400	1,112
Per cent deviation before	-50	-54	-48	-60	-51
Per cent deviation after	+31	+12	+20	- 2	+14
Riboflavin					
Before	1,160	1,199	1,635	1,524	1,363
After	2,238	2,318	2,740	2,276	2,445
Per cent increase	93	100	67	50	73
N. R. C. Allowance	1,200	1,500	1,800	2,000	1,648
Per cent deviation before	- 3	-20	-10	-24	-17
Per cent deviation after	+86	+54	+52	+13	+48
Vitamin C					
Before	32	29	41	49	38
After	65	71	89	97	81
Per cent increase	103	148	117	100	113
N. R. C. Allowance	50	60	75	80	67
Per cent deviation before	-36	-51	-45	-39	-43
Per cent deviation after	+30	+18	+19	+25	+21

85 and 73 per cent for calcium and riboflavin, and over 100 per cent for thiamine and vitamin C, above the original levels (Table IV). The greatest increases were thus in the factors having the greatest initial deficit.

In the case of all nutrients except calories these increases were sufficient to bring the intakes up to or above the recommended allowances, and these failed to attain them on the average by only 6 per cent. This failure to measure up in calories was due largely to the lower intakes of the older girls, some of whom were voluntarily restricting their intakes. The youngest group now exceeded its allowance by 12 per cent and the other two groups were only slightly below theirs. The average protein and thiamine intakes after supplementation were only comfortably above the allowances, averaging 14 per cent for all children. In the case of each nutrient, however, the oldest group scarcely attained them (–3 and –2 per cent, respectively), while the youngest group had a wider margin, (+24 and +31 per cent). Calcium, which was initially 31 per cent below recommended amounts, rose on the average to 28 per cent above them, though the oldest group only barely attained its 100 per cent mark. Vitamin C, which at the outset was 43 per cent below the allowances, rose to 21 per cent above, and the several age groups did not vary greatly from this average. The riboflavin intakes which initially had more closely approached the allowances now exceeded them on the average by 48 per cent. In the youngest group the margin amounted to 86 per cent, while the oldest group had a narrower one of only 13 per cent. Vitamin A, which was well above the allowances at the outset (40 per cent), remained at a high level (28 per cent). As will be shown later, however, the proportion which came from true vitamin A rather than carotene had substantially increased.

It is noted that for most nutrients the youngest group had the most liberal margin over the allowances, while the oldest group only barely, or, as for riboflavin and vitamin C, comfortably attained them. The intakes of individuals in the several groups (which have been omitted to conserve space) did not differ markedly from the averages for their respective groups.

A significant change had also taken place in the ratios of thiamine and riboflavin to calories. It is generally accepted that the thiamine intake bears some relation to energy intake, and that probably riboflavin does also, though the most desirable ratios are not yet agreed upon. There is evidence to indicate that 350 micrograms of thiamine per 1,000 calories is near the lower level of adequacy, and that from 450 to 600 micrograms is a more desirable amount. For riboflavin the advised ratios range from 600 to 800 micrograms or more per 1,000 calories. The ratios provided by the recommended allowances are 500 micrograms of thiamine and 700 to 750 micrograms of riboflavin for each 1,000 calories. At the beginning of this study the thiamine-calorie ratios of the intakes ranged from 265 to 372 micrograms and averaged only 341 micrograms per 1,000 calories for all children (Table V). On the improved diet this average had risen to 635 micrograms, or safely above that provided by the allowances. The riboflavin-calorie ratios were more satisfactory at the outset. Individual ratios ranged from 609 to 1,130, but the averages for the various age groups were all above 750 micrograms, ranging from 826 to 917 micrograms per 1,000 calories.

TABLE V. THIAMINE AND RIBOFLAVIN RATIOS TO CALORIES AT BEGINNING AND END OF STUDY BY AGE GROUPS

AGE GROUP	NO.	THIAMINE MICROGRAMS PER 1,000 CALORIES				RIBOFLAVIN MICROGRAMS PER 1,000 CALORIES			
		BEFORE		AFTER		BEFORE		AFTER	
		RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE
4 to 6	5	324 to 372	342	505 to 750	617	863 to 998	917	1,098 to 1,388	1,191
7 to 9	6	265 to 371	324	589 to 822	671	609 to 996	826	1,049 to 1,571	1,225
10 to 12	9	326 to 361	347	517 to 800	639	816 to 1,130	828	1,002 to 1,967	1,253
13 to 15	5	344 to 360	355	537 to 685	604	796 to 1,042	894	900 to 1,052	998
Average for group	25		341		635		858		1,182
Ratio to calories provided by the N. R. C. Allowances			500			714 to 750			

In the final study the ratios had all increased to 1,000 micrograms per 1,000 calories or above, averaging 1,182. It is thus seen that the increases in intakes of thiamine and riboflavin on the improved diet were sufficiently greater than the increase in calories to result in higher vitamin-calorie ratios for these factors. Some increases in the ratio were evidently desirable, but whether the ones attained were more liberal than necessary is not known.

CONTRIBUTION OF THE DIFFERENT FOODS TO THE DIETARY ESSENTIAL

The increases in the intake of the various nutrients as a result of the supplementation have been noted. It is of interest to analyze these data further to determine what the various food groups, especially the supplementary ones, contributed to these nutrients. The results of this analysis are shown in Table VI.

TABLE VI. PERCENTAGE OF VARIOUS DIETARY ESSENTIALS CONTRIBUTED BY DIFFERENT FOOD GROUPS

	CALORIES	PROTEIN	CALCIUM	VITAMIN A	THIAMINE	RIBOFLAVIN	VITAMIN C
Vegetables and fruits	24.1	11.0	9.7	40.7	45.7	8.9	92.3
Pineapple juice	13.1	2.0	6.4	5.5	31.4	2.8	56.9
Dairy products	38.9	45.1	79.0	43.4	21.7	69.6	6.7
Milk	28.7	39.6	71.5	29.3	20.6	62.5	6.7
Butter	5.3			9.2			
Cheese	2.0	3.7	6.0	2.7	0.4	1.6	
Ice cream	2.9	1.7	1.8	2.2	0.7	3.0	
Bread and cereals	9.8	10.9	4.2		14.4	3.5	
Protein foods	19.2	32.4	4.8	13.6	16.6	15.6	
Meat	8.3	14.6	0.8		8.4	5.1	
Legumes	5.7	7.0	1.5		3.2	1.2	
Eggs	5.2	10.8	2.5	13.6	5.0	9.3	
Other foods (chiefly desserts)	8.2	3.0	1.8	2.3	2.5	2.2	

Dairy Products.—A study of the table shows that when all nutrients are considered, the largest contribution of any group of foods is that made by the dairy products. This is not surprising in view of the fact that milk and butter were consumed practically ad libitum and cheese and ice cream liberally. These foods together furnished 38.9 per cent of the calories, nearly one-half of the pro-

tein (45.1 per cent) and vitamin A (43.4 per cent), and about two-thirds of the calcium (79 per cent) and riboflavin (69.6 per cent) ingested by these children. Thiamine was also furnished in significant amounts (21.7 per cent) and the amount of vitamin C is far from negligible (6.7 per cent). This evaluation is made on the basis of the proportion of total nutrients consumed. For most factors, however, the intakes, as has been shown, were somewhat above estimated needs. When the intakes are computed as per cent of the recommended allowances, the outstanding value of these products is further emphasized. In the amounts eaten they furnished the total allowances for calcium and riboflavin, a full one-half of the protein and vitamin A, and one-fourth of the thiamine. In proportion to their calories, then, dairy products as a group more than carried their share of protein, calcium, vitamin A, and riboflavin, and were not far below it for thiamine. Only in vitamin C (and iron which has not been evaluated) do they fail to do so.

Vegetables and Fruits.—Vegetables and fruits, including potatoes, furnished on the average about one-fourth of the total calories (24.1 per cent). Looking across the table it is seen that the factors which they provided in this percentage or more are vitamin A, thiamine, and vitamin C. Owing largely to the liberal use of greens, these foods furnished 40.7 per cent of the vitamin A value of the diets. In addition they supplied nearly one-half of the thiamine (45.7 per cent) and, as would be expected, practically all of the vitamin C (92.3 per cent). The contribution to other essentials—protein, calcium, and riboflavin—is in each case approximately 10 per cent.

In this group the only supplement provided was pineapple juice. This was introduced into the dietary not for any special food value, as it is well known that it is not a rich source of any nutrient, but chiefly to determine its liking by children and the extent to which it would be accepted day after day for prolonged periods. Pineapple juice is, however, typical of many other common foods, especially fruits, which are only fair or low sources of vitamin C and other factors, and yet which may be consumed in liberal amounts in localities where they are grown or are available at low cost. It was thought of interest, therefore, to determine what such a food, in amounts which are actually eaten, would contribute to the diet. In this case the original diets were below accepted standards for vitamin C, though above the scurvy preventive level, and the plasma levels of the majority of the children were also marginal. For this reason it was decided to add no other fruit or source of vitamin C, except the pineapple juice, to determine whether in the amounts taken voluntarily by the children it would make an appreciable contribution to this factor.

Table VI shows that it did. Out of the total vitamin C in the dietary, the pineapple juice contributed 56.9 per cent. Although its value per 100 c.c. is only 9 to 10 mg., the amounts consumed gave average intakes of 33, 37, 50, and 56 mg. for the four age groups, respectively. This amounted to 67 per cent of the recommended amounts, and was sufficient to bring the total intake well up to and above estimated needs. It also brought the blood values within the normal range, as will be shown in a later paper.

More unexpected was the contribution of pineapple juice to the thiamine need. Of the total intake, it contributed 31.4 per cent; but this amounted to 36.3 per cent of the recommended allowances. It is apparent from the table that thiamine is not as a rule furnished by any one rich food, but by smaller amounts from several sources. Thus, any food that furnishes one-third of the total need is not to be ignored as a source of this factor.

As has already been indicated, these findings apply equally well to numerous other foods, such as apples, bananas, peaches, potatoes. Although one serving of such foods may supply only from 8 to 13 mg. of vitamin C, or 85 to 100 micrograms of thiamine, if eaten in five or six times this amount, as they commonly are in localities where they are plentiful, they may become significant sources of either or both of these factors. This fact deserves more recognition in practical planning of dietaries than it has commonly received.

Bread and Cereals.—Bread and cereals contributed about 10 per cent of the calories for these children. They carried this proportion or more of protein (10.9 per cent) and thiamine (14.4 per cent) and also iron, although this factor was not computed. They also furnished certain amounts of calcium (4.2 per cent) and riboflavin (3.5 per cent). Actually, the amounts were somewhat larger than these, since the desserts and other foods which are given separately were mostly puddings, cakes, and cookies, which consist largely of cereals. It is realized that this group of foods, when only whole-grain or enriched are used, could properly represent a larger fraction of the calories and hence of other constituents. Their percentage consumption in this case was limited by the more generous use of other foods.

Protein Foods.—Outside of the dairy products already considered the chief sources of protein were meat, eggs, and legumes. Eggs were served each morning, meat at the evening meal, and beans, peanut butter, or cheese—or occasionally an extended meat dish or eggs—at noon. In terms of total nutrients ingested these foods together furnished 19.2 per cent of the calories, 32.4 per cent of the protein, and approximately 16 per cent of the thiamine and riboflavin, as well as proportionately good amounts of iron. When considered in terms of estimated needs, this amounted to 36 per cent of the protein, 19 per cent of the thiamine, and 23 per cent of the riboflavin needed to meet recommended values.

It is noted that meat and legumes both made good contributions in proportion to the amounts eaten. It is recognized that meat could easily make greater contributions. Since it was served once a day, no change was made in the practice. But problems of rationing limited its use to some extent. Even so, it carried its full share of protein, thiamine, riboflavin, as well as iron and some of the B vitamins which were not determined. The value of legumes in relation to the amounts eaten is likewise apparent.

The supplementary food in this group was eggs. Obviously one egg or a little more per day would not be expected to contribute large percentages of the nutrients. In proportion to the amount eaten, however, eggs more than did their share. For the group as a whole they furnished on the average 5 per cent of the calories, and they contributed this amount or more of everything except calcium (2.5 per cent) and vitamin C. In terms of the allowances they supplied

12.1, 19.0, 5.8, and 13.8 per cent, respectively, of the recommended amounts of protein, vitamin A, thiamine, and riboflavin. The high nutritive value of eggs is thus demonstrated in a practical situation.

From the over-all viewpoint it is worthy of note that nearly three-fourths of the protein consumed by these children came from animal sources—meat, eggs, and dairy products—as compared with the one-half to two-thirds commonly recommended. Of significance also is the fact that 57 per cent of the vitamin A was supplied by eggs and dairy products. Indeed, these foods alone furnished an average of about 3,000 I.U. of vitamin A per child per day, an amount which many regard as fully adequate when supplied as true vitamin A rather than carotene. Thus the additional amounts furnished by vegetables and fruits as carotene could probably be regarded as providing a generous margin of safety. Other points which are emphasized by this analysis are: the unique role of milk as a source of calcium and riboflavin; the need for dependence on several good sources of thiamine rather than a single food; and the contribution which may be made by a food which is only a fair source of a nutrient if it is consumed regularly in ample amounts.

DISCUSSION

It has been seen that the initial diets provided the children in this institution did not contain the full amounts of the basic foods commonly advised and that the intakes of nutrients by the individual children failed to measure up to the recommended allowances for most factors. When these foods were provided more liberally the children voluntarily consumed them in amounts even greater than prescribed in the usual dietary pattern and the intake of all nutrients equaled or exceeded the dietary allowances. This does not, of course, necessarily imply that the children were undernourished at the outset. Neither does it mean that the full amounts they received at the end were necessarily essential. The dietary allowances were used as the only practical basis of comparison available. It is recognized that these allowances are tentative ones, since adequate research has not yet been carried out on most of the dietary factors to establish the actual requirements. This is especially true for the B vitamins and vitamin A, and for all factors in adolescence. The needs of individuals also vary. There is, furthermore, disagreement as to the criteria of adequacy to be applied. Some workers are convinced that the minimum amount of a constituent that will prevent obvious clinical signs of deficiency is adequate for all purposes. Others believe that there may be other tissue needs, the deficiencies of which are not readily detected by the usual clinical methods, and that until these are known the amounts provided in practical usage should allow some margin of safety above the level needed to prevent clinical signs. The allowances of the National Research Council were intended to provide some such margin. How wide the margins actually are will not be known until further research is carried out. It doubtless varies with the constituent.

The children of this study were obviously receiving enough of the various nutrients on their original diet to prevent clinical signs of deficiency. In feeding children, however, it is important that all dietary factors are provided in

amounts sufficient to insure that every body tissue and organ has a rich supply of everything it needs for its best growth, development, and functioning. From the results to be reported later on the improvements effected in various aspects of physical status on the supplemented diet it would appear that the original diets were marginal in some of the dietary essentials, especially in thiamine and vitamin C, and possibly in other factors. The improved diet as consumed by the children was apparently liberally adequate, and in some factors probably represented luxus consumption of nutrients in that it provided more of some constituents than were actually needed. This view is supported by the saturation studies determined on blood and urine to be reported. From these and other lines of evidence we are led to believe (1) that the quantities of foods in the dietary pattern are ample, (2) that they will under practical conditions easily provide the amounts of the nutrients in the recommended allowances, and (3) that these allowances are adequate and reasonable to use as guides until further research determines more definitely the amounts required for all body tissues and functions.

The outstanding finding of this study is the high degree of acceptance of the basic foods provided in the liberal diet. It shows that children can and will regularly consume these foods in adequate amounts if they are available and if other conditions are favorable to their acceptance. The initial diets of this institution are typical of those in children's institutions and in many private homes. The desirability of providing the basic foods more liberally, and if possible, in the amounts recommended in the dietary pattern, is indicated.

SUMMARY

The diets of children in an institution were supplemented for a year with all foods necessary to provide the amounts advised in the commonly accepted dietary pattern. The supplements included milk and other dairy products, eggs, whole-grain cereals, and pineapple juice. Daily records were kept of the amounts of each food consumed, and a quantitative dietary study was made at the beginning and close of the year to determine the changes in amounts of various nutrients ingested by the individual children.

The acceptance of all foods was unusually good. In 94 to 99 per cent of times offered all these foods were accepted by the children, usually in amounts equal to or in excess of the dietary pattern.

The original diets were below the recommended dietary allowances for all factors except vitamin A; those most markedly below were thiamine and vitamin C.

The intakes of nutrients on the improved diet were sufficient to bring them up to and in most cases well above the allowances. The specific contributions made by the different foods are described.

Interpreted in connection with the changes in physical status reported in the succeeding papers, it is concluded that the supplemented diet supplied some factor or factors which were present in the initial diet in suboptimal amounts. The applications of these findings to the feeding of children in institutions and elsewhere are discussed.

The over-all expenses of this study were carried by a generous grant from the Hawaiian Pineapple Company. The dairy products were provided by the industries concerned through the courtesy of the National Dairy Council. The eggs were supplied by the Poultry and Egg National Board, and the cereals by the Quaker Oats Company. Grateful acknowledgment is made to the workers in all these groups who were able, often only by great personal effort, to provide a constant supply of foods, in spite of problems inherent in the wartime situation.

Grateful acknowledgment is also made to the director and the staff of the St. George School for their fine cooperation throughout the study.

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RESULTS OF PROVIDING A LIBERALLY ADEQUATE DIET TO CHILDREN IN AN INSTITUTION

II. Growth in Weight and Height

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IN THE preceding article[1] the effects of supplying a liberally adequate diet to children in an institution on their intake of various dietary essentials has been described. The usual diet was supplemented with dairy products, eggs, whole-grain cereals, and pineapple juice in amounts designed to bring the totals provided up to those prescribed in the dietary pattern commonly advised for children of these years. The acceptance of all foods by the children was notably good, and the amounts consumed brought the intakes of nutrients well up to or above the usual recommended allowances. This article describes the effects of this improved dietary on the growth of the children.

Procedure.—Weight and height were determined at four-week intervals throughout the year. All measurements were made at the same time of day and by the same operators. Weights were taken nude on a Fairbanks platform scale. Heights were measured on a stadiometer graduated in tenth inches, using standard procedure.[2]

Since the age range was wide, progress was evaluated in terms of percentage of expected gains made by the subjects during the different periods. By reference to the Baldwin-Wood tables[3] each child's expected gain in weight for the year according to his age, height, and build (tall, medium, short) was obtained; this, divided by thirteen, gave the expected gain for a four-week period. (Hereafter referred to as a month to distinguish it from periods of the study.) His average gain per month for different periods was likewise obtained, and the per cent it represented of his expected gain computed. The percentage of expected gains in height were similarly determined.

It is recognized that such procedure takes no account of seasonal variations in growth, nor of the fact that "expected" gains are but averages and not necessarily applicable to any individual child. Nevertheless, when applied impartially to all subjects it is probably as fair a method of appraising growth as is available. Moreover, many workers have shown that seasonal variations tend to disappear when children are on a wholesome nutrition and health regime.

Owing to wartime restrictions of transportation, it was not feasible to have a control school. Some controls were, however, furnished within the group itself. There was, first, a preliminary period of two months, September and October, before the supplementation was started; and a similar period after it was discontinued. Some of the children (the boarders) had all their meals in

the home; others came in for the day and were present for one or two meals plus the morning serving of pineapple juice. Moreover, some children were present for the entire year, others irregularly or for shorter periods. In evaluating the data the children have been grouped according to the amount of supplementary foods they received. There were innumerable gradations in these. For simplicity they were finally put into two groups for most comparisons: (1) those present throughout, or at least through the school year, with few or no absences, and (2) those present for shorter periods or irregularly throughout the year.

Results.—The extent to which the children in the various groups made their expected gains during the different periods is shown in Table I and Chart I.

TABLE I. NUMBER AND PER CENT OF EACH GROUP MAKING SPECIFIED PER CENT OF EXPECTED GAINS IN WEIGHT IN CONTROL AND SUPPLEMENTARY PERIODS*

PER CENT OF EXPECTED	TOTAL				THROUGHOUT				PART-TIME			
	PREPERIOD		SUPPLEMENT		PREPERIOD		SUPPLEMENT		PREPERIOD		SUPPLEMENT	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Total	101	100.0			74	100.0	74	100.0	27	100.0	27	100.0
Less than expected	58	57.4	28	27.7	39	52.7	18	24.3	19	70.4	10	37.0
Loss	27	26.7	1	1.0	18	24.3	—	—	9	33.3	1	3.7
No gain	11	10.9	—	—	5	6.8	—	—	6	22.2	—	—
1 to 49	8	7.9	5	5.0	8	10.8	3	4.1	—	—	2	7.4
50 to 99	12	11.9	22	21.7	8	10.8	15	20.2	4	14.8	7	25.9
Expected or more	43	42.6	73	72.3	35	47.3	56	75.7	8	29.6	17	63.0
100 to 149	12	11.9	28	27.7	9	12.1	23	31.1	3	11.1	5	18.5
	11	10.9	21	20.8	10	13.5	16	21.6	1	3.7	5	18.5
	20	19.8	24	23.8	16	21.6	17	23.0	4	14.8	7	25.9

*Based on children who were present during both periods.

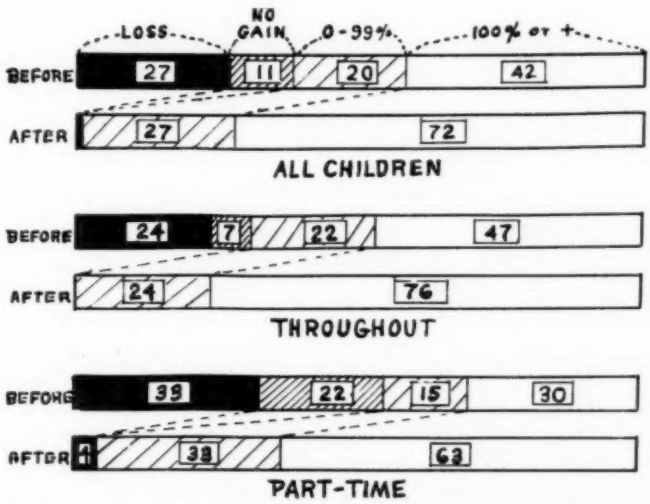

Chart 1.—Per cent of each group making specified percentage of expected gain during control and experimental periods.

During the preperiod the majority of children in all groups averaged less than their expected gain. Of the 101 children who had entered at this time, 27 per cent showed actual losses and 11 per cent failed to gain, making a total of 38 per cent who lost or made no progress. Only 42 per cent of the group made gains equal to or above the expected. This slow gain or loss during the preperiod is of interest in that it came in September and October, which according to the theory of seasonal variations are months when children should make their most rapid gains.

In contrast is the record for the periods of supplementation. Only one child lost, and there were no failures to gain. Moreover, 72 per cent gained their expected amount or more, in contrast with 42 per cent who did so in the preliminary period. The throughout groups greatly improved their record. There were no losses or failures to gain and 76 per cent equaled or exceeded their expected gains. Most of the others (20 per cent) gained from 50 to 99 per cent of the average expected. The part-time groups likewise improved their record, though not quite to the extent of the throughout groups; 63 per cent gained the expected amount or more, as compared with 30 per cent who attained it in the preperiod.

TABLE II. PERCENTAGE OF EXPECTED GAIN IN HEIGHT AND WEIGHT MADE BY EACH GROUP BEFORE, DURING, AND AFTER SUPPLEMENTATION OF DIETS*

	WEIGHT						HEIGHT					
	PREPERIOD		SUPPLEMENTARY		AFTER		PREPERIOD		SUPPLEMENTARY		AFTER	
GROUP	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Total	101	61	153	140	86	124	99	88	152	101	84	131
Throughout	74	79	83	142	66	126	73	88	83	107	64	127
Part-time	27	13	70	129	20	93	26	85	69	93	20	146

*Based on records of all children present during a given period.

The same picture is presented when the average percentage of expected gains for all children in the different groups who were present during a given period is considered (Table II, Chart 2). In the preperiod the group as a whole averaged 61 per cent of its expected gain; in the supplementary period the average had risen to 140 per cent. Again the children present throughout have a somewhat better record than the part-time group, their average gains being 142 and 129 per cent, respectively. The improved gains were moreover maintained in the period after the provision of supplementary foods had been discontinued. This was particularly true of the throughout group whose gains amounted to 79, 142, and 126 per cent of the expected in the periods before, during, and after supplementation, respectively. The part-time group averaged 13, 129, and 93 per cent of their expected amounts for the same periods. This continuance of gain in the after period is significant in view of the fact that it includes the same months of September and October in which poorer than average gains were made in the previous year. It indicates that the improved diet was to some extent at least being continued after the close of the study, as the director of the school had indicated that she intended it to be.

The gains in height were likewise greater during the period of supplementation, especially for the throughout group (Table II, Chart 2). In the preperiod the gains of this group amounted to 88 per cent of the expected; in the supplemented period this percentage rose to 107. The gains of the part-time group likewise increased from 85 per cent of the expected in the preperiod to 93 per cent in the period they were receiving the improved diet. All groups continued their better-than-average gains in height during the after period, even exceeding the gains during the period of supplementation.

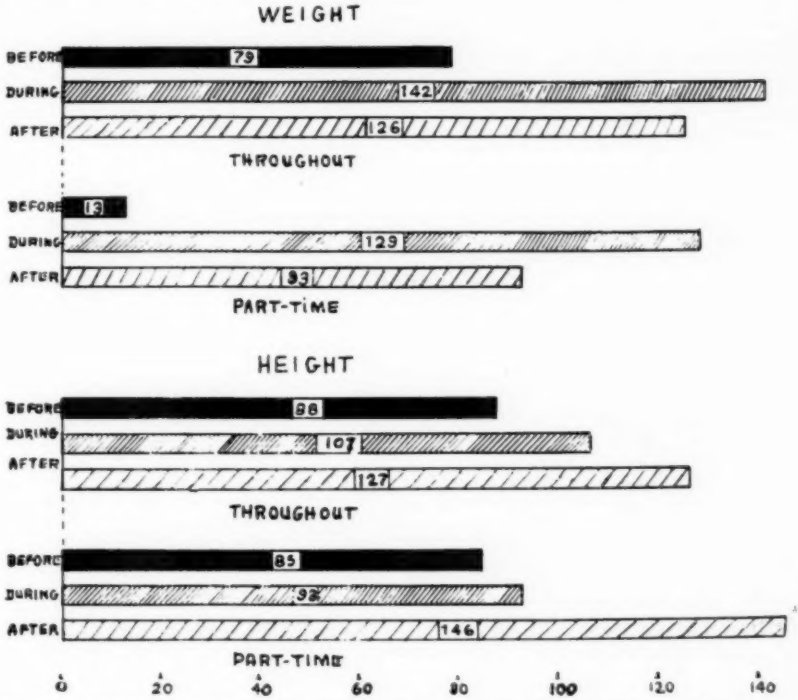

Chart 2.—Percentage of expected gains made by each group, before, during and after supplementation.

Change in Weight-Height Status.—The question at once arises as to whether these better-than-average gains were needed or desirable; and whether the children were in a more favorable status as regards weight in relation to height at the end than at the beginning of the study. (Table III, Chart 3.) Both observation of the children and their weight-height records at the beginning showed them to be a "run of the mill" group. There were relatively few who were significantly underweight (9.3 per cent), but likewise few who would be considered in excellent condition. The majority would be judged only "so-so" in this respect. Over one-third of the entire group (35.1 per cent) were on the underside of average, and another third (30.5 per cent) only slightly above it, from 0 to 6 per cent. A few children were somewhat overweight and one was

TABLE III. NUMBER AND PER CENT OF EACH GROUP IN SPECIFIED WEIGHT ZONE AT BEGINNING AND END OF STUDY

	BEGINNING						END					
	TOTAL		THROUGHOUT		PART-TIME		TOTAL		THROUGHOUT		PART-TIME	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Total	151		83		68		151		83		68	
Under average	53	35.1	30	36.1	23	33.8	39	25.8	20	24.1	19	27.9
10 or more	9	6.0	5	6.0	4	5.9	7	4.6	3	3.6	4	5.9
7 to 9	5	3.3	4	4.8	1	1.4	8	5.3	3	3.6	5	7.2
0 to 6	39	25.8	21	25.3	18	26.5	24	15.9	14	16.9	10	14.7
Average or above	98	64.9	53	63.9	45	66.2	112	74.2	63	75.9	49	72.1
1 to 6	46	30.5	24	29.0	22	32.4	53	35.1	28	33.7	25	36.8
7 to 9	17	11.2	10	12.0	7	10.3	19	12.6	8	9.6	11	16.2
10 to 14	20	13.2	10	12.0	10	14.8	23	15.2	16	19.2	7	10.3
15 to 19	7	4.6	5	6.0	2	2.9	7	4.6	4	4.8	3	4.4
20 or more	8	5.3	4	4.8	4	5.8	10	6.6	7	8.5	3	4.4

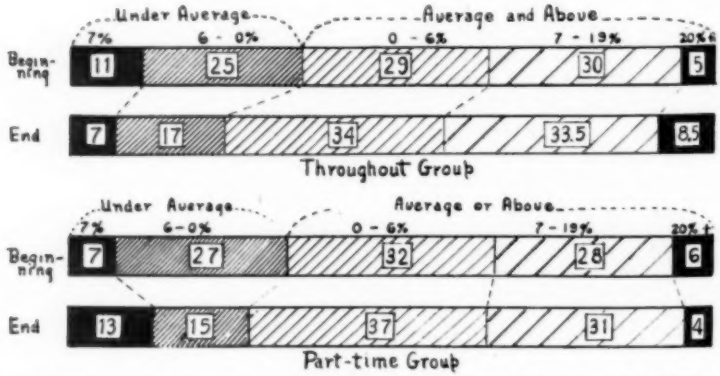

Chart 3.—Percentage of children in each group in specified weight zone at beginning and at end of study.

definitely obese. Since it is generally observed that well-nourished children are usually above average weight by 7 per cent or more, it is probably fair to conclude that at least the two-thirds of the children who were below this zone could profitably improve their weight in relation to height; that is, put a little more fat and muscle padding over their bony frameworks. It may also be assumed that those 20 per cent or more above average were tending toward obesity and that restriction of weight gain in relation to height might be desirable.

It has been seen that the gains of the children of this study exceeded the expected for both height and weight. Did the gains in weight outstrip those for height sufficiently to change their weight-height status significantly? Chart 3 shows that at the end of the year there has been an appreciable shift to more favorable weight zones in both groups. In the throughout group the proportion below average weight has decreased from 36 to 24 per cent and those significantly below from 11 to 7 per cent. There has likewise been a corresponding increase in the number in the more favorable weight zones. In a few cases the increase

has been sufficient to bring the child into the overweight zone. None of these, however, would be considered obese. The part-time group shows a similar but less marked shift. The percentage under average weight has decreased from 34 to 28, but those significantly below have increased from 7 to 13 per cent, and the percentage in the more favorable weight zone remained approximately the same.

TABLE IV. PERCENTAGE OF CHILDREN IN EACH GROUP WHO IMPROVED THEIR HEIGHT-WEIGHT STATUS DURING THE YEAR

STATUS AT BEGINNING	TOTAL	THROUGHOUT							PART-TIME						
		TOTAL	IMPROVED		SAME		LESS FAVORABLE		TOTAL	IMPROVED		SAME		LESS FAVORABLE	
		NO.	NO.	%	NO.	%	NO.	%	NO.	NO.	%	NO.	%	NO.	%
Improvement desirable	107	58	32	55	17	30	9	15	49	20	41	14	29	15	31
Under average weight	53	30	15	50	11	37	4	13	23	8	35	5	22	10	43
Average to 6% above	46	24	16	67	4	16	4	16	22	11	50	7	32	4	18
Overweight 20% or more	8	4	1	25	2	50	1	25	4	1	25	2	50	1	25

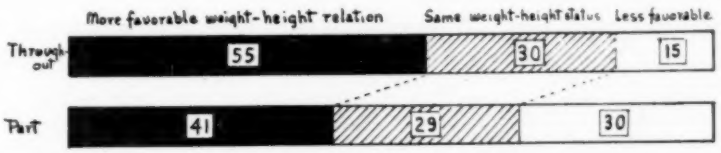

Chart 4.—Percentage of children in each group who had more favorable weight-height status at the end than at the beginning.

This tendency of the groups to shift to more favorable weight zones does not, however, tell the whole story, for a given child may improve his weight-height relation and yet remain in the same zone (e.g., from –15 per cent to –11 per cent). This was true of many children in this study. The records of the 107 children who, it was judged, could profitably improve their weight-height status were examined to determine the extent to which they did so. (Table IV, Chart 4.) In the throughout group 55 per cent had a more favorable weight-height relation at the end than at the beginning, 30 per cent had held their original status, and only 15 per cent had a less favorable one. Again the part-time group shows the same trend, but to lesser degree; 41 per cent improved their weight-height status, 29 per cent held the same, and 31 per cent had less favorable status than at the beginning. The 44 children who were judged to have satisfactory weight for height at the beginning either maintained their status or made minor shifts within the same zone.

DISCUSSION

Although the study lacked the desirable control of a carefully matched group, it is apparent from the comparisons which have been presented that the dietary supplementation had a beneficial effect on the growth of the children who received it. This is shown (1) by the better growth in both weight and height

during the period they were receiving the supplements than during the period before it was begun; (2) by the improvement in weight-height status of the majority of the group during the year; and (3) by the better record made on all counts by the children who were present throughout the study and regularly received the improved diet than those who received it less regularly or for shorter periods.

Is not this what would naturally be expected? Not if the diets the children were already receiving were fully adequate in all dietary essentials; yes, if these diets were suboptimal in one or more respects. It is a generally accepted theory that the upper limits of a child's growth in stature, at least, is set by heredity and that because of inadequate nutrition or other fatcors he may fail to attain it, but that he will not exceed his hereditary pattern. The better growth in height of these children in the proportion that they received the more liberal diet would suggest that the original diet was susceptible of improvement. The same is true to lesser extent for weight, for in this the increases may be out of proportion to height gains and cause undesirable overweight. This did not appear to be the case in the present study. As has been indicated, though few of the children would have been considered significantly underweight, the large majority, it was judged, both by appearance and weight records, would profit by some additional weight in relation to their skeletal build. Their better-than-average gains in weight helped to bring a majority of the group into a more favorable weight-height relationship than they had at the beginning. For only three or four of the older girls were the added gains beyond what was needed or desirable. These changes in weight-height status are more significant than at first appears, for as has been pointed out by Turner[4] and others, children tend to stay in the same zone, and it is a real achievement when a child, who needs it, can by improved nutrition be brought into a more favorable weight-height status.

The question may be asked, Why did not all children gain up to their "expected" amounts? In the first place, as earlier pointed out, "expected" gains in both weight and height are arbitrary averages and the amount calculated from the tables of averages for a given child may not be his true expected gain. Such appraisals are justifiable in comparing progress of groups but cannot be applied sharply to the gains of individual children within the groups. There were, however, some real failures to gain. These were due largely to illnesses and to a few children who were poorer eaters than the others. The fact that gains of these children during the supplementary period overcame the usual seasonal pattern is especially significant. Their greater gains in weight during the winter and spring months when gains are commonly at their lowest and when colds are at their height, as compared with the actual losses or poorer gains during the preperiod in September and October, when gains are supposed to be greatest, is testimony to the value and stabilizing effect of the improved dietary. This finding, together with the better and more regular gains of the groups that received the diet more regularly and for longer periods, makes it seem fair to conclude, then, that the food supplements added something to the previous

institution diet that was not provided in optimal amounts. Some indication of what these limitations might be are given in the succeeding article.

SUMMARY

The growth in weight and height of 151 children in an institution was followed throughout a year during which time the diets were supplemented with all foods necessary to bring them up to the usual recommended dietary pattern. Comparisons were made of the rate of gain before, during, and after supplementation, and also between the gains of the children present throughout and those present irregularly or for shorter periods. The beneficial effects were shown by the following:

1. In the preperiod, the group as a whole averaged 61 per cent of its expected gain in weight; in the supplementary period the percentage rose to 140 per cent, and gains continued at a high level in the after period. The gains for height followed a similar pattern.

2. The percentage of children under average weight for height decreased, and there was a definite shift of the group toward more favorable weight-height status.

3. By every basis of comparison the group which was present throughout, and had the benefits of the improved diet for the year, fared significantly better than those present irregularly or for shorter periods.

It seems justifiable to conclude that the supplementary foods supplied some one or more dietary factors that were not present in the institution diet in optimal amounts. Until the requirements for the various essentials are better known, the desirability of providing the basic foods in amounts approximating those in the commonly recommended dietary pattern is indicated.

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RESULTS OF PROVIDING A LIBERALLY ADEQUATE DIET TO CHILDREN IN AN INSTITUTION

III. Blood and Urinary Excretion Studies Before and After Dietary Improvement

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THIS report deals with a study of the blood levels of vitamin A, carotene, vitamin C, serum protein, hemoglobin, and thiamine, and with the fasting one-hour excretions and test dose returns of thiamine and riboflavin found in a group of boarding school children before and after extensive supplementation of the diet. It was thought that this information could be used to a certain extent in judging the nutritional status of these children and that it also would furnish information as to the blood levels, fasting one-hour excretions, and test dose returns of normal children who were known to have received an excellent diet for a comparatively long period of time. A description of the school, the details of the study, and the general procedures followed have been given in another publication.[1]

EXPERIMENTAL PROCEDURES

General.—The blood and urinary excretion studies were made in October after the regular institutional diet had been consumed for three to eight weeks. Plasma vitamin C levels and urinary excretions of thiamine and riboflavin were determined again four months after the diet was improved and the entire study as made in the autumn was repeated after six months of supplementation.* With the exception of vitamin C plasma levels which were determined on both day children and boarders, the blood and urinary studies were made only on the regular boarders.

Dietary Studies.—Dietary studies were made in September and May. The amounts of different foods eaten by individual children were weighed and the average daily intakes of calories, protein, vitamin A, vitamin C, thiamine, riboflavin, and calcium were calculated for the different age groups on the institutional and the improved diets. These studies have been described in detail in another publication.[1]

Blood Studies.—Approximately 10 ml. of blood was drawn before breakfast by venipuncture. Appropriate amounts of each sample were oxalated for vitamin C and thiamine determinations and the rest was allowed to clot. It was immediately transported to the laboratory and all analyses were completed on the day it was drawn. Vitamin A and carotene were determined by the method of May and associates[2] and the conversion to international units of

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*The supplements consisted of milk, eggs, butter, cheese, whole-grain cereals, pineapple juice, and ice cream.

vitamin A and micrograms of carotene were made by using the factors of Yarbrough and Dann.[3] Vitamin C was determined by the micromethod of Farmer and Abt[4] and when it was the only substance analyzed, blood was obtained from finger pricks. Thiamine analyses were made by the microfermentation method of Atkin, Schultz, and Frey[5] as described by Knott and associates.[6] Total nitrogen determinations were made by the micro-Kjeldahl method of Pregl[7] and serum protein calculated by using the factor 6.25. Hemoglobin determinations were made by the method of Evelyn.[8]

Urinary Excretion Studies.—The collection of all urine specimens was under the supervision of the nutritionist who resided at the school. The fasting one-hour specimens were collected before breakfast. The four-hour collections following the oral administration of test doses of both thiamine and riboflavin were made in the period between breakfast and lunch. The test doses of 75 micrograms per kilogram of body weight of these vitamins were given on different mornings with low-vitamin breakfasts consisting of apple juice, unenriched puffed rice, sugar, a small amount of cream, soda crackers, and butter. The test dose returns were considered to be the total excretion of the vitamin during the four-hour period immediately following the administration of the test dose. Neither fasting one-hour excretions nor test dose returns were studied until the middle of the week on children who left school over the week end. Also, care was taken that no liver or pork was eaten the day before either test. Thiamine determinations on all urine samples were made by the microfermentation method. Riboflavin assays were carried out according to the microbiological method of Snell and Strong[9] as modified by Strong and Carpenter.[10]

RESULTS AND DISCUSSION

Dietary Studies

On the institutional diet, the average intakes of the different age groups (4 to 6 years; 7 to 9 years; 10 to 12 years; and 13 to 15 years) were for the most part significantly lower than those recommended by the Food and Nutrition Board of the National Research Council. The intakes on this diet were especially low in thiamine and vitamin C and were below the recommended allowances for all nutrients except vitamin A.

On the supplemented diet, the average intakes of all the age groups equaled or exceeded the recommended allowances.

Blood Studies

The blood studies were made on a group of thirty-nine children in October and forty in May. Thirty-one children were the same in both groups. Their ages ranged from 6 to 15 years.

Vitamin A and Carotene.—In October the average vitamin A content of the serum was 111 I.U. per 100 ml. (Chart 1). The values obtained on individual children varied from 75 to 255 I.U. and all were within the range considered normal by Lewis and associates.[11] In May after six months on the supplemented diet the average vitamin A content of the serum (114 I.U. per 100 ml.) as well as the range (70 to 224 I.U.) was approximately the same as in

October. This was not surprising since the vitamin A intakes on the institutional and the improved diets were approximately the same and ranged from slightly over 4,000 I.U. in the lower to around 6,000 I.U. in the upper age groups—amounts which are above the recommended allowances for this vitamin. It does indicate, however, the relative ease in obtaining adequate amounts of vitamin A from a diet which is only fair in other respects.

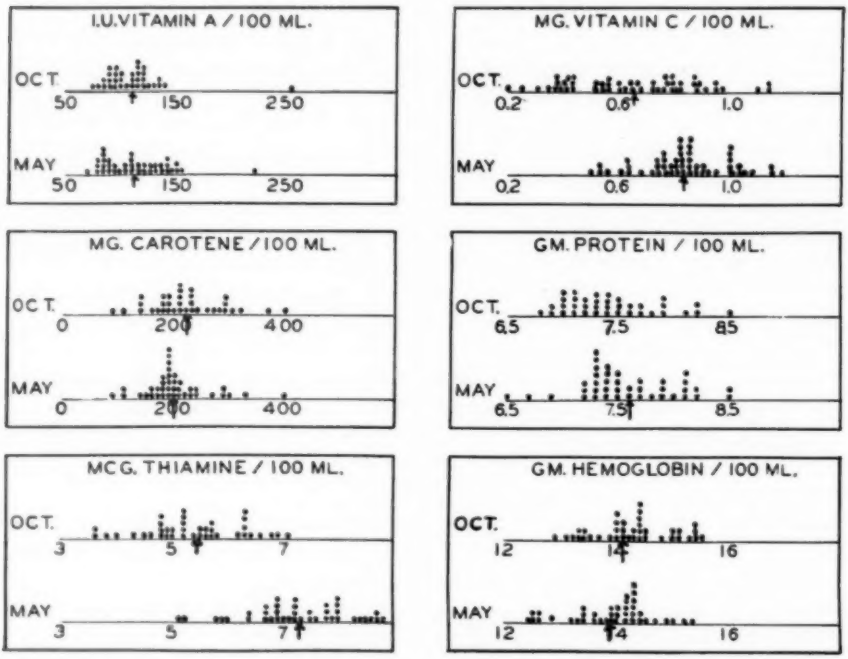

Chart 1.—Blood levels of a group of boarders before and after supplementation of the diet. (Arrows indicate average values.)

The average carotene content of the blood was 220 mg. per 100 ml. in October and 202 mg. per 100 ml. in May.

Vitamin C.—Since the only addition to the institutional diet which contributed appreciable amounts of vitamin C was the pineapple juice which was available to both the boarders and the day children, the vitamin C levels of the blood plasma of both groups were determined at the beginning of the year and again in March and May. By the end of the year a total of sixty-one children had been examined three times and an additional fifty had been examined twice.

The results were analyzed first by considering only the boarders, since the vitamin C intakes of the day pupils were not known. The average blood level of a group of fifty-one boarders was 0.65 mg. per cent in October and 0.83 mg. per cent in May (Chart 1). Forty-one per cent of these children had blood

levels of less than 0.6 mg. per cent, and 16 per cent had blood levels of less than 0.4 mg. per cent in October. This seems to indicate that the institutional diet, on which the average daily vitamin C intakes were 32, 29, 41 and 49 mg., respectively, for the different age groups, was not adequate in this vitamin.

In May most of the blood levels were between 0.7 and 0.9 mg. per cent. Only 8 per cent had blood levels of less than 0.6 mg. per cent and none had less than 0.5 mg. per cent. This indicated that the improved diet on which the average daily vitamin C intakes were 65, 71, 89, and 97 mg. for the different age groups probably could be considered as adequate but not excessively high. Since the intakes on the improved diet were not greatly different from those recommended by the Food and Nutrition Board of the National Research Council for children of these ages, these results lend further support to their suggested allowances.

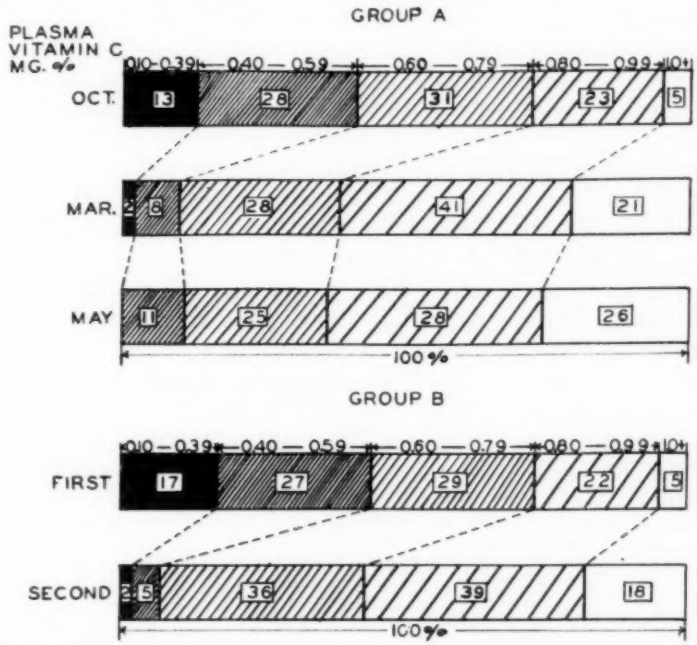

Chart 2.—Plasma vitamin C levels before and after supplementation of the diet. (Group A represents children on whom three and Group B those on whom two or more values were obtained.)

The data were further analyzed by considering first, all children (boarders and day pupils) whose blood levels were determined three times, i.e., those who had received the pineapple juice supplement for the entire six months. There were 61 such children and they were designated as Group A. Next, a comparison was made of the first and second determinations on the 111 children (Group B) who had been examined two or more times. The second values for those of this group who had been examined more than twice was arrived at by averaging the results of the last two determinations. The results of this analysis show (Chart

2) that the blood vitamin C levels of the entire school showed the same general picture as those of the smaller group of boarders. Over 40 per cent of both Group A and Group B, as was the case with the boarders, had levels of less than 0.6 mg. per cent in October. In May only 11 per cent of Group A and 7 per cent of Group B fell in this range. Therefore, it can be concluded that the nutritional status with respect to vitamin C as judged by plasma levels of both day children and boarders was benefited by the supplement containing this vitamin.

Serum Protein.—The average serum protein in October was 7.4 Gm. per cent as compared with 7.6 Gm. per cent in May (Chart 1). No abnormally low serum proteins were found at any time, which indicated that these children were in a satisfactory state of protein nutrition on both the institutional and the improved diet. However, it does not necessarily follow that the institutional diet was adequate in protein since stores built up by the diet of the previous summer might have been responsible in part for the October serum protein levels. Therefore, while it can be stated with certainty that the improved diet which contained 62, 69, 82, and 78 Gm. of protein for the different age groups was adequate, there is no way of judging whether or not the lower levels of 41, 45, 60, and 58 Gm. furnished by the institutional diet were also adequate. The protein intakes on the improved diet averaged 14 per cent higher and those on the institutional diet 20 per cent lower than the recommended allowances.

Hemoglobin.—The average hemoglobin value was 14.1 Gm. per 100 ml. of blood in October and 13.9 Gm. in May. No abnormally low levels were found at any time.

Since some of the children had been at the institution for several years (including summers), it was evident that the institutional diet had furnished sufficient amounts of iron for normal hemoglobin formation. Therefore, it became of interest to ascertain the iron intakes on this diet. To accomplish this, the average daily iron intakes of eight children who had lived at the school for two to five years were determined by making individual food composites for each child for a period of eight days and analyzing for their iron content.* The intakes of the 7- to 8-year-olds ranged from 7.8 to 10.2 mg. (average 9.0) and those of the 10- to 12-year-olds ranged from 9.7 to 12.0 mg. (average 10.7). These amounts are slightly lower than the recommended allowances of 10 and 12 mg. for these age groups. That the amounts furnished by the institutional diet were adequate is further substantiated by the fact that, after receiving higher iron intakes on the improved diet, the hemoglobin values did not increase.

Thiamine.—The average thiamine content of the blood in October was 5.5 micrograms per 100 ml. (Chart 1.) Thirty-three per cent of the children examined had levels of less than 5 micrograms per cent and 95 per cent had levels of less than 7 micrograms per cent (Chart 3). The average in May was 7.3 micrograms per cent with none lower than 5 micrograms per cent and with 38 per cent lower than 7 micrograms per cent.

*The iron content of the diets was determined by Dr. Frances Johnston.

Although there is not enough evidence at the present time to justify a rigid standard for blood thiamine, levels of less than 5 micrograms per cent are considered undesirable by most investigators in this field. If that is true, the institutional diet was inadequate with respect to thiamine. The improved diet supported blood levels of this magnitude in the entire group and of 7 micrograms per cent or more in 62 per cent of the children and therefore could be judged as adequate.

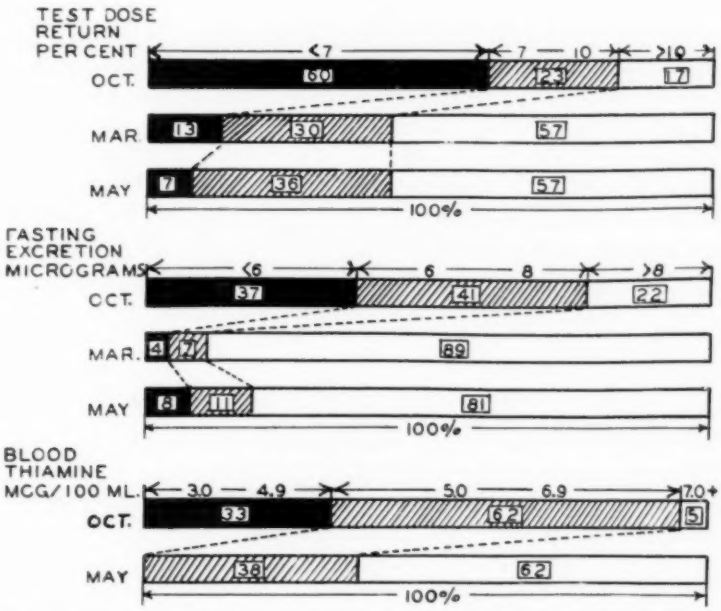

Chart 3.—Thiamine test dose returns, fasting one-hour excretions, and blood levels before and after supplementation of the diet.

These results may also be examined as to their contribution to the limited amount of data on the thiamine content of the blood of normal children on an ad libitum consumption of a good diet. Under these conditions most of the blood thiamines of this group fell between 6 and 8 micrograms per cent. This agrees fairly well with the mean value of 7.8 ± 1.3 micrograms per cent found by Benson and associates[12] on a group of forty-five children, from 4 to 12 years of age, who were receiving an adequate intake and indicates that the blood thiamine of healthy children of all ages should approximate these amounts.

EXCRETION STUDIES

Thiamine.—The returns in four hours of oral test doses of 75 micrograms of thiamine per kilogram of body weight, were determined in October, March, and May on a group of thirty boarders. The fasting one-hour excretions were studied at approximately the same times in twenty-seven of this group. In both tests

decidedly higher results were obtained after the improvement of the diet (Chart 3). For example, 60 per cent of the group returned less than 7 per cent of test doses in October as compared with 7 per cent in May. In the case of fasting excretions, 37 per cent were less than 6 micrograms in October as compared with 8 per cent in May. Since the blood thiamines also showed a marked increase after the supplements were added, and since the institutional diet furnished lower amounts of thiamine than are usually considered adequate it would seem that the nutritional status of these children with respect to thiamine was definitely better on the improved than on the institutional diet.

The average daily intakes of thiamine on the institutional diet were approximately 450 micrograms for the two lower and 600 micrograms for the two upper age groups while those on the improved diet were approximately 1,100 micrograms and 1,400 micrograms, respectively. Although it is quite conceivable that the improved diet furnished higher amounts of thiamine than were actually needed by these children, it does seem that the thiamine intakes on the institutional diet were too low to insure adequacy with respect to this vitamin.

These data also furnish additional information as to urinary thiamine levels in normal healthy children with an ad libitum consumption of a good diet. They indicate that such children, for the most part, will have four-hour test dose returns of 7 per cent or more and fasting one-hour excretions of 6 micrograms or more.

These levels for fasting one-hour excretions and four-hour test dose returns agree quite well with those found on two 5-year-old boys[13] who were studied under controlled conditions. Their four-hour test dose returns were less than 7 per cent and their fasting one-hour excretions were less than 6 micrograms on intakes of 500 micrograms or less, but increased to these amounts or more on intakes of approximately 700 micrograms of thiamine.

Whether children having levels lower than these should be considered mildly deficient in thiamine is difficult to say. It does seem, however, that these levels give a better assurance of protection than lower ones.

Riboflavin.—The four-hour returns of oral test doses of 75 micrograms of riboflavin per kilogram of body weight were determined on the same thirty-seven children in October, March, and May. The fasting one-hour excretions of thirty-six of these children were assayed for their riboflavin content at approximately the same time.

The test dose returns in the spring showed no appreciable change from those in the autumn (Chart 4) in spite of the decided increase in the riboflavin content of the diet. Thus it seems that these children were receiving adequate amounts of riboflavin on the institutional diet. This interpretation is further substantiated by the fact that 95 per cent of the group were returning 20 per cent or more of their test doses in the autumn. This amount was that returned by the two 5-year-old children mentioned previously,[13] when they were receiving the amount of riboflavin that was judged to be their requirement.

The fasting one-hour excretions, on the other hand, showed definite increases when the riboflavin intake was higher (Chart 4). The averages for the group

in October, March, and May were 29, 48 and 47 micrograms, respectively. However, almost all (94 per cent) of the children had excretions of 9 micrograms or more in October which was the amount excreted by the two 5-year-old boys when they were receiving enough riboflavin to meet their requirements. This again indicates the adequacy of the institutional diet in riboflavin.

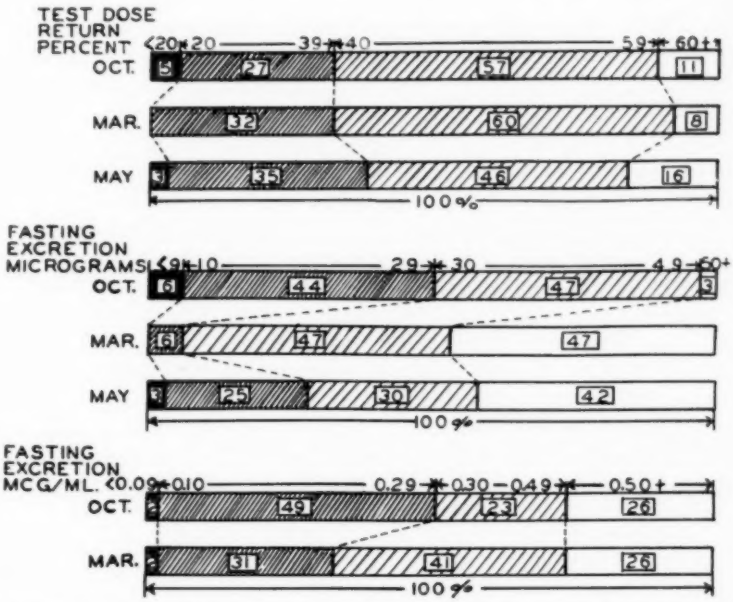

Chart 4.—Riboflavin test dose returns and fasting one-hour excretions before and after supplementation of the diet.

When the fasting one-hour excretions of riboflavin were expressed on a microgram per milliliter of urine basis as was suggested by Feder and associates,[14] the values in March did not show such a pronounced increase over those of October. The average of the group in October was 0.34 microgram per milliliter as compared with 0.42 microgram per milliliter in March. If only those who excreted 0.3 micrograms per milliliter of urine were considered normal, as was also suggested by these authors, 51 per cent of the children studied would have been classed as deficient in October and 33 per cent in March (Chart 4). That this was the case is highly improbable since the riboflavin intakes were exceptionally high on the improved diet. However, if all excretions above 0.1 microgram per milliliter are considered normal, only 2 per cent of the group would have been rated as deficient in both October and March, which according to the test dose returns appeared to be the case. Therefore, if fasting one-hour excretions, expressed on a unit volume basis, are used to judge the nutritional status of children with respect to riboflavin, it would seem that only those excreting less than 0.1 microgram per milliliter should be considered undesirably low.

The average daily intakes of riboflavin on the institutional diet were approximately 1,150, 1,200, 1,600, and 1,500 micrograms for the different age groups. These intakes are lower than the recommended allowances. However, in all cases they represent more than two-thirds of the recommended allowances, which was the amount that appeared to satisfy the requirements of the two 5-year-old boys in the earlier study.[13] Since the test dose returns of the children in this study were no higher on the improved diet when the average daily intakes were well over 2,000 micrograms for all age groups it would seem that there is no justification for recommending intakes higher than those of the institutional diet.

The Usefulness of Excretion Studies in Evaluating Nutritional Status With Respect to Thiamine and Riboflavin.—The results obtained in this study indicate that in general, excretion studies, especially test dose returns, when properly interpreted, do reflect the nutritional status with respect to thiamine and riboflavin. A large number of the children studied had been receiving undesirably low thiamine intakes on the institutional diet. This was reflected both in the low fasting excretions and the low test dose returns of a high percentage of the group. In the spring after these children had received an excellent diet for six months, the improvement in their nutritional status was shown by higher excretions in both tests. On the other hand, the riboflavin intakes on the institutional diet were more satisfactory than those of thiamine. This was reflected by both the fasting excretions and the low test dose returns of a high percentage of the group. In the spring after these children had received an excellent diet for six months the improvement in their nutritional status was shown by higher excretions in both tests. On the other hand, the riboflavin intakes on the institutional diet were more satisfactory than those of thiamine. This was reflected by both the fasting excretions and the test dose returns. In the spring, after much higher riboflavin intakes, the test dose returns remained the same, indicating no improvement in the nutritional status with respect to riboflavin. It is true, that the fasting excretions of riboflavin, like those of thiamine showed a marked increase in March and in May. This is interpreted to mean that the fasting excretions roughly parallel the intakes over a wide range. This is not surprising since the amounts excreted in the fasting one-hour period are relatively small and as a result are not limited by kidney function as may be the case with the excretions in response to test doses. It would seem that the one-hour fasting excretions are most useful when abnormally low amounts are excreted and that when these amounts are in the normal range further increases do not necessarily mean an improved nutritional status.

SUMMARY AND CONCLUSIONS

The blood levels of vitamin A, carotene, hemoglobin and thiamine and the serum proteins were determined on a group of 39 boarding school children; plasma vitamin C determinations were made on the entire population of the school; fasting one-hour excretions and 4-hour returns of thiamine and riboflavin test doses were studied on groups of 30 or more children. All determina-

tions were made in the autumn when the children were receiving the institutional diet and were repeated in the spring after the diet had been improved by extensive supplementation which brought the intakes of all nutrients up to or in excess of the recommended allowances.

The only values which were undesirably low on the institutional diet and which were significantly improved on the supplemented diet were those concerned with vitamin C and thiamine. Both plasma vitamin C and blood thiamine levels which in many children were low in the autumn showed significant improvement in the spring. The test dose returns and one-hour fasting excretions of thiamine which were also low in many cases on the institutional diet were higher on the improved diet.

The riboflavin test dose returns which were relatively high on the institutional diet showed no significant change on the supplemented diet. The fasting one-hour excretions of riboflavin, however, were considerably higher in the spring than in the autumn.

These results are in complete agreement with those of a dietary study reported in a preceding paper which showed the institutional diet to be most markedly below the recommended dietary allowances in thiamine and vitamin C. This furnishes further support to the usefulness of biochemical measurements of nutritional status.

Until such time as additional evidence is presented, it is suggested: that normal children who have been consuming the type of diet that is generally recommended will have in the majority of cases blood values which are not appreciably lower than 0.6 mg. per cent of vitamin C, 6 micrograms per cent of thiamine, and 75 I.U. per cent of vitamin A; that they will return 7 per cent or more of an oral test dose of 75 micrograms per kilogram of thiamine and 20 per cent or more of a similar test dose of riboflavin in four hours; and that the fasting one-hour excretions of thiamine and riboflavin will not be significantly less than 6 and 9 micrograms, respectively.

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THE CRYING OF NEWLY BORN BABIES

III. The Early Period at Home

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THIS report concerns the third of a series of investigations as to the nature of infantile crying in the postnatal period. In the first two reports,[1, 2] the crying of a group of babies during their stay in a hospital nursery for newly born infants was studied. In this article we are reporting on the period at home, immediately after their hospital experience.

Having found out how much crying took place in the hospital nursery, and having studied its causes from both community and individual aspects,[1, 2] we were interested to learn what happened to the babies at a slightly older age and under markedly changed environmental conditions.

Instead of being subject to the air-conditioned, brightly illuminated physical surroundings and somewhat routinized care of the hospital nursery, the babies found themselves in a much more flexible environment at home. To quote Gesell and associates,[3] the household is a "cultural workshop where human relationships are first formed." Individual care in the arms of his mother and prompt response to his needs were new experiences for each baby.

All crying of newly born infants obviously is not bad or evidence of poor handling, since the initial cry after birth has a lifesaving function in helping the lungs to expand and, later on, the use of the cry as a signal of need is a normal function of babies. However, when the cry is prolonged unduly or becomes the usual pattern of behavior, we feel the need to intervene and to ameliorate the situation. It should not be necessary for a baby to cry more than three minutes to indicate an ordinary need.

It should be stated that the mothers of all the babies studied were urged to investigate the cause for each crying outburst and to treat each cause appropriately. Furthermore, they were instructed to adjust the feeding schedule to the rhythm indicated by each individual baby, rather than to maintain a strictly prearranged regimen. It was explained to them that, even when the cause of crying was not evident, it was beneficial to pick up the baby and try a little fondling. The soothing use of rocking chairs and lullabies was suggested.

THE METHOD

The babies studied in this report were born between March 13, and June 30, 1944. By far the majority stayed in the hospital for a period of nine to ten days.

A special form was prepared and distributed to each mother on her dismissal to her home. At the top of the form, such basic data as the name of the baby, the clinic number, the date of birth, sex, birth weight and present weight

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were filled in. Then followed a blank tabular form in which the seven days of the week were arranged in a vertical column and twenty-four hourly periods were arranged horizontally, so that each horizontal space represented one whole day.

The mother was instructed to mark out on the chart a continuous line from the beginning to the end of any crying period of more than three minutes. At the same time, the mother was asked to associate each crying spell with one or more of the following possible causes: (a) hunger, (b) vomiting, (c) association with stool, (d) association with urination, (e) chilling, (f) overheating, (g) bath, (h) noise, (i) light and (j) unknown reason. Four such weekly sheets were given to each mother, who was requested to complete the home observation within a period of four weeks.

THE RESULTS

I. The Basic Data.—

(1) The return of the forms.—Forty-two mothers, undoubtedly those who gave us the most active interest and sincere cooperation, sent back the forms with data duly filled in. The records of their forty-two babies form the basis of this report.

(2) Social status of the families.—Because most of the maternity patients come from the city of Rochester and its vicinity, the occupations of the families differ from those of the average American town (Table I). One-third of the babies had fathers holding medical or dental degrees. While we realize that this is an unusual sampling, we infer that the social status of this group of young mothers is above average, and that this may add more weight to the reliability of the data presented than is usual in lay records.

TABLE I. OCCUPATIONS OF THE FATHERS OF INFANTS UNDER STUDY

	NUMBER	PERCENTAGE
Physician or dentist	14	33.3
In service	12	28.6
Workman	5	11.9
Businessman	4	9.5
Clerk	3	7.1
Farmer	3	7.1
Minister	1	2.4
Totnl	42	100.0

(3) Sex.—Of the forty-two babies under study, twenty-seven (64.3 per cent) were males and fifteen (35.7 per cent) were females.

(4) Age.—There were some variations of age among the infants under study (Table II). The youngest age at which home observation was started was 8 days and the oldest 22 days. At the conclusion of the observation, the youngest infant was then 15 days old and the oldest 46 days of age. All observations, therefore, were made on babies less than 7 weeks of age.

(5) Number of days of observation.—There was considerable variation also in the number of days of observation by the mothers (Table II). For example, the mother in Case 3 reported for only six days, while the mothers in Cases 24 and 38 observed for as long as thirty-three days. But, by far the majority of

the mothers (thirty-three, or 78.6 per cent) recorded for at least sixteen days. The arithmetical average for the duration of observation was twenty-one days.

II. Results.—

(1) Crying spells.—The average number of prolonged crying spells per day for each individual baby is presented in Column 4 of Table II. One is im-

TABLE II. THE CRYING OF FORTY-TWO INFANTS LESS THAN SEVEN WEEKS OF AGE AT HOME: NUMBER OF PROLONGED SPELLS AND CAUSES

CASE	AGE IN DAYS AT BEGINNING AND END OF OBSERVATION	NUMBER OF DAYS OF OBSERVATION	AVERAGE NUMBER OF CRYING SPELLS PER DAY	TOTAL NUMBER OF CAUSES	PROBABLE CAUSES OF CRYING SPELLS AVERAGE FREQUENCY OF EACH CAUSE PER DAY									
					HUNGER (a)	VOMITING (b)	ASSOCIATION WITH STOOL (c)	ASSOCIATION WITH URINATION (d)	CHILLING (e)	OVERHEATING (f)	BATH (g)	LIGHT (h)	NOISE (i)	UNKNOWN REASON (j)
1	13-34	22	7.5	10.1	4.40	0	1.69	1.95	0	0.18	0.91	0	0	1.00
2	10-12													
	14-24	14	7.1	7.1	2.43	0.14	1.08	0.29	0.07	0	0.21	0	0	2.94
3	10-15	6	4.3	4.8	2.17	0.17	0.33	0	0	0	1.17	0	0	1.00
4	12-39	28	6.0	6.3	4.20	0.43	0.25	0.04	0.07	0.04	0.18	0	0	1.14
5	10-16	7	8.6	8.6	2.57	0.29	2.72	2.43	0	0.14	0.29	0	0	0.14
6	12-29	18	2.2	2.7	0.50	0	0.05	0.11	0	0.44	0.83	0	0	0.78
7	8-30	23	0.6	0.6	0.31	0	0	0	0	0.04	0.04	0	0	0.09
8	14-41	28	7.2	7.2	5.98	0	0.18	0	0	0	0.11	0	0	0.97
9	9-31	23	5.0	5.1	2.22	0.31	0.48	0.13	0	0.26	0.52	0.04	0	1.13
10	12-39	28	8.5	17.2	8.20	0	1.22	7.20	0	0	0.54	0	0	0.71
11	16-39	24	5.4	5.4	2.88	0.17	0.38	0.38	0	0.17	0	0	0	1.46
12	17-44	28	6.5	6.6	4.82	0.14	0.57	0.11	0.04	0	0.50	0	0	0.46
13	11-31	21	3.0	3.0	1.92	0	0.19	0.05	0	0.05	0.43	0	0	0.33
14	10-24	15	2.7	2.9	0.67	0	0.47	0.87	0	0.07	0.27	0	0	0.53
15	12-39	28	5.5	6.9	2.57	0	1.07	2.97	0.04	0	0.14	0	0	0.14
16	11-30	20	6.4	7.0	3.70	0.10	0.15	0.70	0	0.05	0.45	0	0	0.85
17	22-46	25	0.8	0.8	0.68	0	0	0	0	0	0	0	0	0.12
18	15-29	15	2.9	2.9	1.22	0	0	0.72	0	0.14	0	0	0	0.79
19	8-28	21	2.1	2.3	1.34	0	0.24	0.09	0	0	0.43	0.09	0	0.14
20	13-19	7	1.4	1.4	0	6	0.29	0	0	0	0	0	0	1.14
21	11-38	28	3.3	3.3	1.36	0	0.04	0	0.18	0	0.50	0	0	1.18
22	9-29	21	4.6	6.1	3.80	0.05	0.67	0.81	0	0.28	0.43	0	0	0
23	9-31	23	1.0	1.0	0.52	0.04	0	0	0	0.09	0.04	0	0	0.26
24	10-42	33	2.0	2.1	1.22	0	0.15	0.03	0	0.03	0.09	0.03	0.03	0.49
25	11-24	14	1.8	2.4	1.29	0	0.36	0	0	0.14	0.29	0.07	0	0.21
26	12-31	20	3.0	3.0	0.85	0	0.60	0.20	0	0	0.55	0	0	0.75
27	9-27	19	0.6	0.6	0.26	0.16	0	0	0	0	0	0.11	0.05	0.05
28	11-26	16	4.8	5.3	1.32	0.06	0.75	0.88	0	0	0.44	0	0	1.82
29	10-34	25	2.8	3.0	0.24	0	0.08	0	0	0	0.48	0	0.32	1.84
30	9-28	20	11.1	12.3	6.67	0.55	0.85	0.35	0	0.05	0.95	0	0	2.86
31	10-33	24	6.8	7.7	4.59	0	0.50	0.54	0	0.71	0.63	0.04	0	0.67
32	10-28	19	2.6	3.1	2.06	0	0	0.69	0	0	0.21	0	0.05	0.05
33	9-35	27	2.9	2.9	2.70	0	0	0.19	0	0	0	0	0	0
34	9-36	28	1.6	5.1	1.58	0.04	0.72	2.00	0	0.07	0.39	0	0	0.29
35	9-15	7	1.7	1.7	0.57	0	0	0	0	0	1.00	0	0	0.14
36	9-35	27	2.3	2.6	0.84	0	0.15	0.96	0	0.04	0.11	0	0	0.52
37	8-23	16	4.0	4.1	2.50	0	1.00	0.31	0	0	0.13	0	0	0.19
38	9-41	33	3.4	3.9	2.00	0.03	0.67	0.52	0.06	0.09	0.06	0	0	0.49
39	8-28	21	4.8	4.5	2.91	0.05	0.67	0.57	0	0.05	0.41	0	0	0.14
40	9-22	14	4.6	4.7	0.79	0	0.86	0.79	0.07	0	0.43	0	0	1.79
41	12-38	27	4.9	4.9	1.11	0	0.33	0.07	0.14	0	0.07	0	0	3.15
42	9-30	22	1.6	1.6	0.91	0	0	0	0	0	0.32	0	0	0.32
Average		21	4.0	4.6	2.21	0.07	0.47	0.64	0.02	0.07	0.35	0.01	0.01	0.79

mediately impressed by these figures, because they are so much lower than those presented in our previous studies on the situation in the hospital nursery. To classify the babies of this series as "quiet babies," "average babies," and "crying babies" on the same basis as we did in the hospital studies is not possible, for practically all the babies under home conditions would have to be put under the category of "quiet babies." No attempt is made, therefore, to classify them according to the amount of crying per day.

Returning to the data in Table II we see that three babies averaged less than one crying episode a day; six babies, one to two episodes; nine babies, two to three episodes; four babies, three to four episodes; seven babies, four to five episodes; twelve babies, five to ten episodes, and one baby (Case 30) had on an average 11.1 episodes per day. The average for the group was 4.0 crying episodes per baby per day.

It should be mentioned that in order to make the procedure as direct and simple as possible we did not ask the mothers to include the number of minutes for each crying episode. One mother (Case 38) attempted this on her own initiative and noted down carefully the duration of each crying episode. For a period of observation of thirty-three days, the baby in Case 38 cried from one minute to twenty-eight minutes a day, averaging nine minutes per day. The average baby in the hospital cried that much every hour.

(2) Multiple causes for crying.—As emphasized in our reports on infantile crying in the hospital nursery,[1] the determination of the cause or causes for each crying spell depends on the observer's personal judgment. Obviously, this also holds true for the mothers in the home. Often the mothers listed more than one cause for a single crying episode. It is quite likely that in doing this they were correct, for two factors might easily be responsible for a single spell. In the fifth column of Table II, we try to show this by placing the total number of causes responsible for the crying spells for each individual baby on an average day by the side of the average number of crying spells for each individual baby on an average day, which has been given in the fourth column of Table II. In examining these two columns, one can see that in seventeen instances, the two columns bear equal numbers. These seventeen mothers evidently felt that on each occasion there was only one cause for crying. But the other twenty-five mothers occasionally put down two or even three causes for a single crying episode, thus making the total number of causes for crying exceed the total number of spells. Such a discrepancy could be as big as between 17.2 (the average number of causes per day) and 8.5 (the average number of crying spells per day) as in Case 10, but, for the whole group, the average of the number of the different causes per baby per day is 4.6 in contrast to 4.0, which is the figure for the average number of crying spells per baby per day.

(3) The individual causes of crying.—Each of the figures presented in the ten columns in the right side of Table II represents the frequency of that particular cause, on an average day, for each individual baby. Each figure was obtained by dividing the total frequency of each cause throughout the period of observation by the number of days of observation by the mother at home. For

example, the baby in Case 1 was observed for a period of twenty-two days at home. During these twenty-two days, he had altogether 165 crying episodes, ninety-seven of which were considered either partly or entirely due to hunger. He averaged, then, 7.5 crying episodes each day and 4.4 of these 7.5 crying episodes were either partly or entirely due to hunger. Similarly 1.7 of these 7.5 crying episodes were partly or entirely associated with stools; 2.0, with urine; 0.2, with overheating; 0.9, with bathing, and 1.0, with unknown reasons.

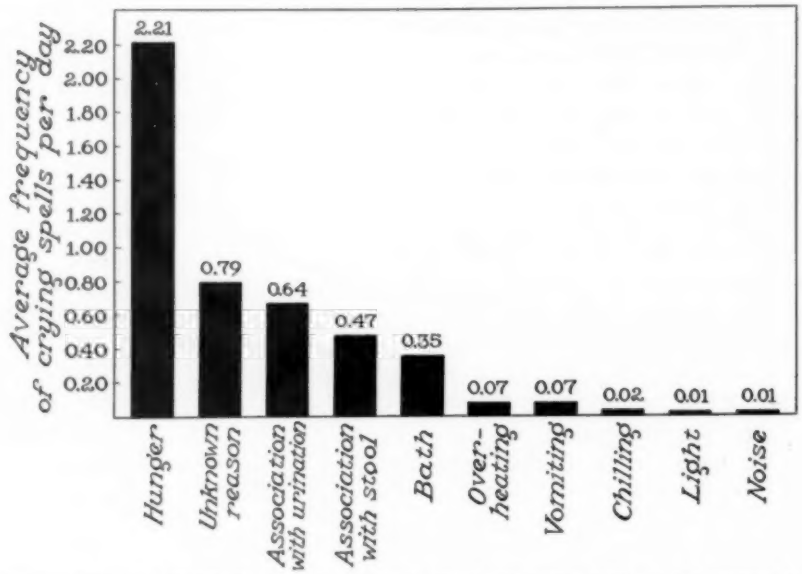

Fig. 1.—Frequency distribution of the different causes of crying spells of an average baby on an average day.

(a) Hunger: Hunger (Table II) heads all the other causes responsible for the crying episodes of an average day in thirty cases, holds the second place in eight cases, and the third, in three cases. In one (Case 20), a relatively quiet baby, the mother thought that he had never cried for hunger. On an average day, out of the 4.0 crying episodes, an average baby cried 2.2 times for hunger (Fig. 1).* It must be remembered that episodes of less than three minutes were not included.

(b) Vomiting: Vomiting was a relatively unimportant factor among these babies. Only in Case 27, in which the subject was a comparatively quiet baby having an average of 0.63 crying episodes per day, did vomiting occupy second place among the causes. But in this case the importance was apparent rather than real, for when we turn to the raw data, the baby cried only three times on account of vomiting throughout a period of nineteen days. Vomiting amounts

*Relating to this and the following nine paragraphs, the frequency distribution of the different causes of crying spells in an average baby on an average day is graphically presented in Fig. 1.

to a negligible factor in the causation of crying (less than 0.1 crying spell per day per average baby).

(c) Association with stool: This did not head the causes in any single case. In eight cases, it held second place, and in twelve cases, third place. In nine cases, no crying episode at all was accounted for by a soiled diaper. On the average, 0.47 of 4.0 crying spells per day were due to this factor.

(d) Association with urine: In four babies, a wet diaper apparently caused the most crying spells during an average day. In twelve babies, however, there were no crying spells at all which could be accounted for by urination. For the whole group, 0.64 of 4.0 crying spells per average day were associated with this factor. Of course, we could not determine whether the wetness or the contraction of the bladder wall was responsible.

(e) Chilling: In eight cases, chilling was occasionally mentioned as the cause of a crying episode, but in the entire group this was a negligible factor.

(f) Overheating: In twenty-one cases, this factor was blamed for crying. In Case 31 it held second place among all the causes, although it was only a seventh as frequent as the coexisting chief cause, "hunger." For the group, it was unimportant, for it accounted for less than 0.1 on an average day per baby.

(g) Bathing: Infants at this age evidently did not appreciate their baths, as in only six cases was the bath omitted as a cause of crying. In examining the original charts, crying accompanying the bath was almost as routine as the daily bath itself. It accounted for 0.35 of 4.0 episodes of crying in an average day. Considering the fact that bathing occurred only once a day, this value, though numerically small, has some significance. It should be stated that no baths were given in the hospital; so this was a new experience.

(h) Noise: This was mentioned in four babies' charts but its significance as a cause of crying in an average home was slight. The mother in Case 29 put down "noise" as the cause of crying spells seven times in four successive days out of her twenty-five days of observation.

(i) Light: Six mothers tried to correlate response to light with the crying spells. For the whole group of infants, light is obviously not a common factor.

(j) Unknown reasons: Many crying spells perplexed the mothers. Six mothers listed "unknown reason" most frequently as the cause of their babies' crying. Fifteen mothers put it second in the list. On the other hand, the mothers in Cases 22 and 33 thought that every one of their babies' crying spells could be given adequate explanation. On the average 0.79 out of 4.0 spells of crying each day in our group could not be adequately explained by the mother.

(k) Miscellaneous: These were not tabulated separately on account of their infrequent occurrence and were listed under "j" in the calculation. The mother in Case 7 mentioned "gas distention" twice as the cause of crying spells in a period of twenty-three days of observation. The mother in Case 14 thought "hiccup" had caused one spell of her baby's crying during her fifteen days of observation. The mother in Case 27 mentioned the word "colic" once in her nineteen days of observation and the mother in Case 35 did the same once in seven days.

COMMENT

Before appraising these results, certain limitations of our data should be recognized. First of all, the babies varied in age at the onset of observations from 8 days at one extreme to 22 days at the other. The periods of observation also varied from six days to thirty-three days. This difference in age as compared with that of the babies studied in our hospital survey may account for some of the differences in crying habits. This must be borne in mind in appraising the results. Then, each mother possessed her own individual attitude and judgment, which necessarily affected the uniformity of our report. And, unfortunately, we could not obtain the duration of each crying episode in minutes. All these points make the present investigation differ from our previous studies on neonatal crying. On the other hand, all the babies reported here were receiving individual nursing care by the person making the report. The observations made by a mother on her own baby are individualized, whereas in our hospital survey, four observers in turn had to watch over twenty babies simultaneously, making the appraisal of causes more difficult.

The most significant fact revealed by this study was that on the average the babies cried many less times in the home than in the hospital nursery. An average baby in the nursery for newly born infants had 11.9 prolonged crying episodes each day, while at home, the number dropped to 4.0 per day. This seems to imply that the babies' negatively directed reactions were reduced when the nursing care was individualized. While the value of home environment and mothering cannot be measured in mathematical terms, it can be detected by this objective study as a definite aid to the comfort of these babies.

It is interesting that more crying episodes were given a definite explanation by the mothers than by the hospital observers. In our previous hospital nursery survey,[1] 48.5 per cent of all the crying spells were described as due to "unknown reason," while in this home study only 19.8 per cent of prolonged episodes were so classified. Hunger accounted for 32.5 per cent of the crying episodes in the hospital nursery study, but the figure rose to 55.3 per cent at home. Perhaps the reduction in unknown episodes was due to the fact that the individualized care eliminated some of those *needs* to cry; hence there were fewer unexplained spells.

However, it is significant to note that in the present study a relatively high percentage of crying spells was still unexplainable to observers as close to the babies as their own mothers. This poses a challenge to us for further research and insight into the subject.

Regarding the other causes of crying, there seems to be a parallel between the data obtained in the hospital nursery survey and those recorded in the home study. In both situations, as one would expect, wet diapers caused more crying spells than soiled diapers, and vomiting caused fewer episodes than either.

The reactions to bathing were somewhat surprising. In the hospital, since we do not bathe the babies at all, we did not have any figures on this subject. Although most of the time mothers listed the bath as a single cause of crying, the bath usually took place at least an hour or two after the previous feeding

and hunger might, therefore, have played a partial role in certain instances. A few mothers reported that when orange juice was offered just before the bath, the baby was quiet throughout and at times even seemed to enjoy the procedure.

This home survey was being carried on during the early summer months. The maximal temperature at Rochester, Minn., in April, 1944, was 68° F.; in May, 87° F.; and in June, 93° F. The homes were not air-conditioned as was the hospital nursery; so that overheating caused some crying spells among the youngsters. Conversely, chilling was not common.

Hearing is known to be acute among newly born infants and their light perception is also well developed. Sudden loud noise and glaring light may stimulate the babies, but in ordinary household surroundings they did not play a great role as a cause of crying.

Finally, this study further reveals the truth borne out by the oft-quoted theme that babies are different.[4]

SUMMARY AND CONCLUSIONS

Under home observation and with the cooperation of their mothers, data were collected on the crying episodes of forty-two infants less than 7 weeks of age. The following conclusions were drawn:

1. On an average day, an average baby at home had 4.0 prolonged crying spells, in contrast to the figure of 11.9 for babies in the nursery for newly born infants.

2. Again in contrast to our former hospital nursery survey, hunger clearly led the list of causes of crying at home, and "unknown reason" dropped to only 14.2 per cent of all the causes. Wet diaper, soiled diaper, and vomiting remain in the same order as minor causes of crying episodes.

3. Most of these babies cried during the daily bath.

4. Hot weather may account for a small percentage of the crying of infants during the summer months.

5. Noise and light were the least likely causes of the crying of young infants at home.

6. This study further confirms the statement that babies are different in respect to crying.

7. Since babies showed fewer negatively directed reactions when given individualized nursing care at home, it is suggested that further improvement in the care of babies in hospitals might follow individualization of nursing care for each infant.

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PENICILLIN THERAPY OF STAPHYLOCOCCUS AUREUS HEMOLYTICUS INFECTION IN AN ALLERGIC INFANT

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THE following case history is believed to be of general interest because of the complicated clinical course and relatively large amounts of penicillin required in treatment. The presence of a severe food allergy increased the difficulty in maintaining nutrition during the long period of illness.

Intravenous therapy was made difficult by the presence of weeping eczematous lesions in the antecubital and cervical areas and crusted eczematous lesions about the wrists and ankles. One blood transfusion was given by vein and one into the bone marrow. Otherwise parenteral solutions were administered by hypodermoclysis.

The correlation between clinical course, therapy, and feeding regime is indicated in the accompanying chart (Fig. 1).

CASE HISTORY

R. J. was first seen in our pediatric clinic on March 9, 1944, aged 2½ months, with a fine papulovesicular eruption on face and neck of two weeks' duration. Next visit was on May 16, 1944, with a history of intermittent fever of two days' duration, vomiting and three to four loose stools daily. On May 22, 1944, vomiting and diarrhea had ceased, but cough and difficult breathing had developed. He was reported to have had high fever for two nights and to have refused feedings. He was admitted to the hospital.

Family History.—He was the third child in the family. Father, mother, and two siblings were living and well. Mother had antisyphilitic treatment for several years and had regular antisyphilitic treatment for seven months before the birth of this child. Maternal grandfather had hay fever. Maternal aunt had pulmonary tuberculosis. Maternal cousin had asthma. No other familial disease history.

Past History.—Baby was born at full term, normal delivery on Dec. 21, 1943. Birth weight was 7 pounds, 13 ounces. He was breast fed since birth. A cod-liver oil concentrate was begun at the age of 2 months; orange juice was offered several times and each time the skin eruption on face became more severe so that it was discontinued.

Physical examination on admission revealed a well-developed, moderately well-nourished, Negro male infant of 5 months, apparently ill and in respiratory distress. Temperature 101° F., pulse and respiration rapid. Skin moderately dehydrated. Mild seborrheic eruption of face and neck. Head normal in size and shape. Anterior fontanel open. No depression or bulging. Eyes and ears negative. Pharynx slightly injected. Gums edentulous. Tongue coated and dry, oral mucosa dry. Chest: symmetrical, normal development, equal expansion. Percussion resonant throughout. Occasional coarse wheezing and rhonchal sounds on auscultation. Heart: no apparent enlargement, rate rapid, rhythm regular, no murmurs: sounds of good quality. Abdomen: distended; no tenderness, no masses or organs palpated. Normal male genitalia, phimosis. Extremities normally developed. Reflexes physiological. Excoriated and partially denuded weeping areas in antecubital and axillary regions.

Child remained in the hospital for one hundred twenty-seven days. The original admission was for treatment of bronchitis and mild eczema. Because of the high leucocyte

From The Babies' Hospital of Philadelphia.
†Deceased.

count, chemotherapy, in the form of sulfathiazole, was used, as well as croup tent and cough medicine. By the tenth hospital day bronchitis had cleared, but there was persistent nasal discharge. Rhonchi and occasional wheezing râles were audible over the chest, throughout most of the hospital period. Report of the x-ray of the chest on the thirty-eighth day was as follows:

"*Right Lung*: There are somewhat prominent markings with possible light superimposed spots at the cardiophrenic angle. The heart border and diaphragm are smooth and sharply defined.

Left Lung: There is similar prominence of markings at the base mesially with superimposed light spots behind and lateral to the cardiac apex.

Heart: The heart appears normal in size and shape and position. The abdomen is distended and there is an unusually large amount of gas in both the stomach and intestines.

Comment: Presumably this child has bronchitis complicating the gastrointestinal disease. However, there is no abnormality of heart or lungs of importance at the present time. There is no pulmonary lesion to explain recurrent fever."

On the twelfth day thrush lesions appeared on the tongue and buccal mucosa. This infection was attributed to poor hygiene on the part of the mother who was coming in several times daily for breast feedings. Because of the infection and because breast milk was failing rapidly, breast feeding was discontinued at this time. The thrush infection was very resistant to treatment and did not entirely disappear until penicillin was given for the other complicating infection.

A complementary feeding made with boiled milk was begun on the sixth day and by the fifteenth day this formula made up the entire feeding. Diarrhea began on the eighteenth day and formula was changed to skim milk. Persistence of diarrhea, marked abdominal distention and distress, and a flare-up of eczematous lesions suggested an allergy to cows' milk. He was then placed on a milk-free preparation (Sobee) on which he continued throughout most of his hospital stay. Because of recurrent diarrhea another milk-free product (Nutramigen) was later substituted. The diet was gradually increased by adding liver soup and certain vegetables as they were tolerated. In addition, vitamin therapy and Amigen solution by mouth were used, as tolerated.

From the day of admission, temperature was septic in type with occasional periods of forty-eight to seventy-two hours, during which elevation was not excessive. There appeared to be only slight relation between the clinical course and the temperature curve. The same was true of the leucocyte count, although this was doubtless affected to some extent by the chemotherapy used at various times. The patient frequently appeared comfortable, ate well, and gained in weight, while the temperature ranged as high as 103 to 105° F. Numerous laboratory tests were negative for specific infection. A blood culture was taken on the thirteenth day. This showed no growth until the ninth day when a subculture showed *Staphylococcus anhemolyticus*. This was interpreted by the laboratory as a contamination and was so accepted by the clinicians, as at the time of this report the child was gaining well and had had two days of essentially normal temperature. Three subsequent cultures were negative. Repeated urinalyses were negative. Tuberculin patch test and Mantoux tests were negative. Blood Wassermann was negative. Agglutination tests for typhoid, paratyphoid, dysentery, paradysentery, and brucellosis were negative.

On the fifty-eighth day many small nodules were noted over the scalp area. These were rather firm, deep seated, freely movable, and about the size of a pea or slightly larger. The postauricular and postcervical nodes were also enlarged. One nodule, somewhat softer than the others, was incised and pus obtained. This pus produced a pure culture of *Staphylococcus aureus hemolyticus*. A throat culture, taken five days earlier, also showed *Staphylococcus aureus*. A blood culture taken at the same time as the throat culture was reported negative. Penicillin therapy was begun on the sixtieth day. Five thousand units

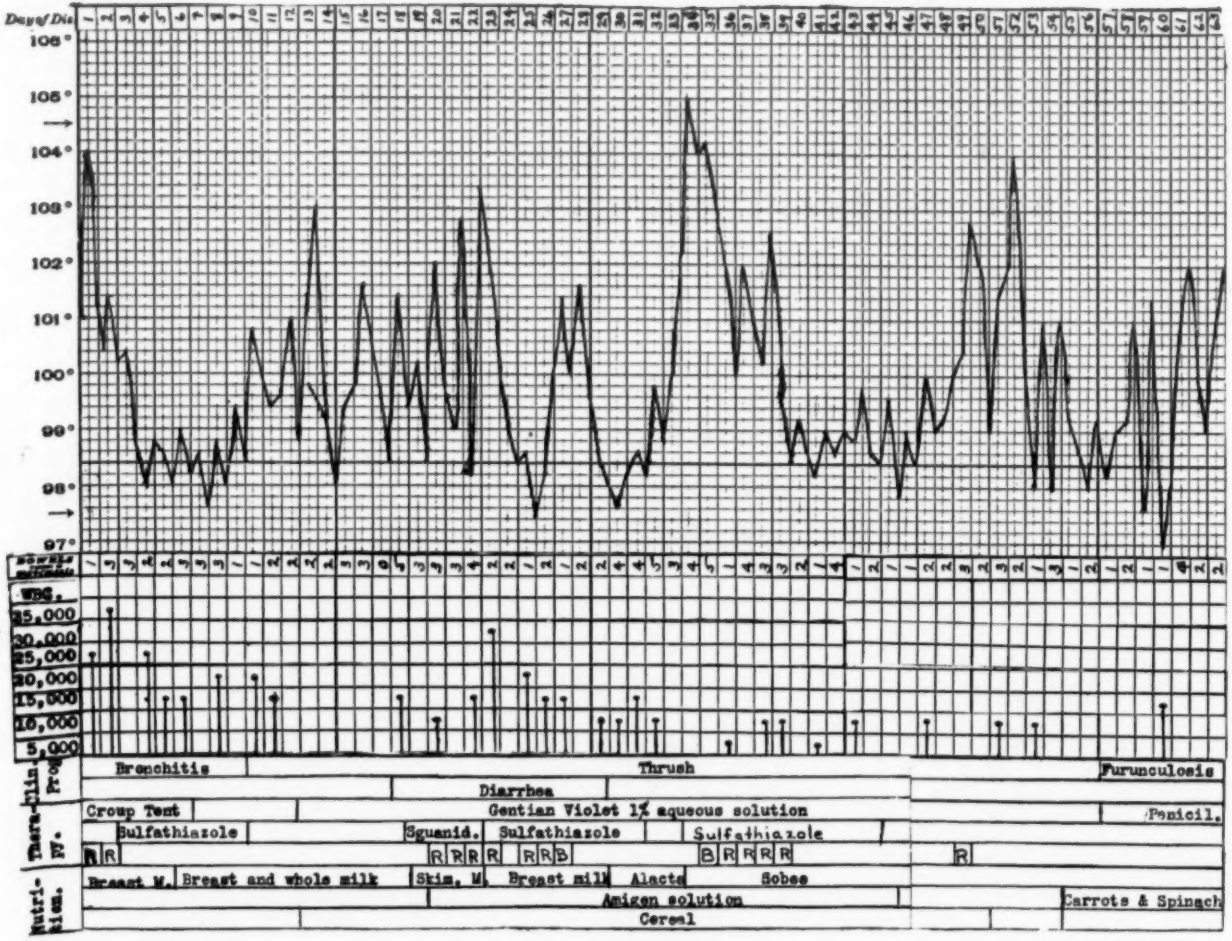
Day of Dis.
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°
WBC.
35,000
30,000
25,000
20,000
15,000
10,000
5,000
Bronchitis
Thrush
Furunculosis
Diarrhea
Croup Tent
Gentian Violet 1% aqueous solution
Penicil.
Sulfathiazole
Sguanid.
Sulfathiazole
Sulfathiazole
Breast M.
Breast and whole milk
Skim. M.
Breast milk
Alacta
Sobee
Amigen solution
Carrots & Spinach
Cereal

Fig. 1.

Day of Dis.
106°

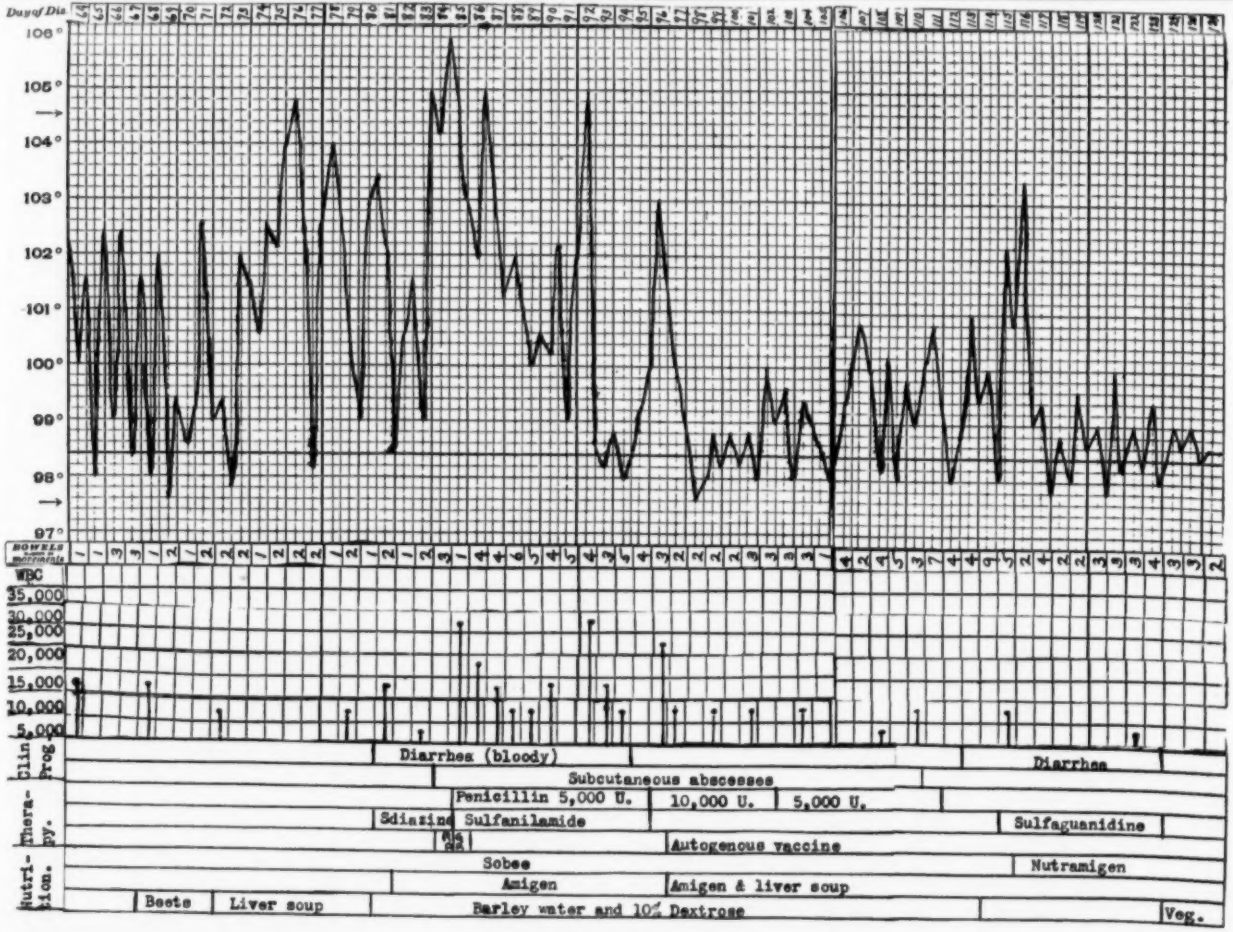

Fig. 1.—Continued.

Fig. 1.—*R*, Lactate Ringer's solution (hypodermoclysis); *G*, glucose solution (hypodermoclysis); *A*, solution of amino acids (hypodermoclysis); *B*, blood transfusion; penicillin dosage recorded is 1/12 of amount given in twenty-four hours.

were given every two hours up to a total of 200,000 units. A few of the furuncles were incised. The others were apparently absorbed without becoming fluctuant. Penicillin was discontinued as the child seemed clinically well even though there was still a moderate daily elevation of temperature. Incidentally, during this period of treatment, the persistent thrush infection and the nasal discharge, which had been present since admission, both disappeared. Temperature range continued between 102 and 97° F. although the child was clinically well, gaining weight, and eating well.

On the seventy-sixth day, about two weeks after penicillin was discontinued, temperature rose to 105° F. without demonstrable clinical cause. On the eighty-first day, he began to have watery stools containing mucus, pus, and blood. These stools were large but not frequent. Culture showed *Bacillus coli*. Examination of the lower rectum revealed no pathology. Abdomen was distended and child was unable to retain fluids by mouth. Lactate-ringer solution, glucose solution, and solution of amino acids were given by hypodermoclysis. Barley water, weak tea, and 10 per cent dextrose were given in small amounts by mouth. A blood culture taken at this time was later reported negative. Chemotherapy in the form of sulfadiazine was begun with no appreciable change in temperature or clinical picture. Abdominal distention increased and there were abdominal tenderness and boardlike rigidity. He was seen by a surgical consultant who felt that the abdominal picture was the result of generalized infection, rather than intra-abdominal pathology. As he had previously had a staphylococcus skin infection, and had responded well to penicillin therapy, this was resumed in doses of 5,000 units every two hours, intramuscularly. The following day, temperature rose to 106° F., abdomen remained distended, and a tender indurated area appeared over the right lower quadrant of the abdomen. This was nonfluctuating and not well demarcated. Child was seen by a second surgical consultant, who felt that there might be an intra-abdominal or retroperitoneal abscess as part of a generalized septicemia. He made an incision in the indurated area of the abdominal wall but obtained no pus. As this area was the site of previous hypodermoclysis, he suggested discontinuation of this and giving fluids by mouth or proctoclysis. A stool culture at this time showed streptococci as well as staphylococcus and *B. coli*. As temperature elevation persisted and leucocytosis was present, sulfanilamide was added to penicillin therapy. Condition remained critical. New areas of induration appeared over the lower abdomen and over the posterior chest wall. One was incised and pus obtained. A second one was aspirated and pus obtained for culture. This showed *Staph. aureus hemolyticus*. An autogenous vaccine was requested. There was slight clinical improvement, but temperature was still moderately elevated and abscess areas continued to drain. Sulfanilamide was discontinued. Penicillin was increased to 10,000 units every two hours, or 120,000 units in twenty-four hours. This dosage was continued for six days, with subsidence of temperature and leucocytosis. Then 60,000 units daily was continued until drainage of abscesses ceased. In all, a total of 2,000,000 units of penicillin was given. The autogenous vaccine was begun before the end of penicillin treatment and was continued until after discharge from the hospital.

Two days after penicillin was discontinued, stools again became watery and frequent with occasional small amounts of mucus and blood. Temperature was again elevated and sulfaguanidine was begun and continued for nine days, until stools became normal. As he was not taking his formula (Sobee) well another milk substitute (Nutramigen) was used and well taken. A stool culture at this time showed only *B. coli*. Temperature range was normal during the last ten days in the hospital. Skin was clear and clinical condition good.

Child was discharged after one hundred twenty-seven days in the hospital, having gained three pounds over his admission weight. Autogenous vaccine was continued in the outpatient department. There was no recurrence of abscess formation or temperature elevation and general progress was good for one month. He was then readmitted to the hospital for treatment of pneumonia and responded very well to treatment with sulfadiazine. He is again progressing satisfactorily and is being followed through the outpatient department.

SUMMARY

The case history of a 5-month-old Negro male infant with severe allergic tendencies complicated by infection has been presented. During his one hundred twenty-seven days of hospitalization he had clinical evidence of persistent upper respiratory infection, bronchitis, and thrush infection, three episodes of diarrhea, furunculosis of scalp and forehead with cervical lymphadenopathy and multiple subcutaneous abscesses. Throughout his stay he had a septic type of temperature elevation. Aside from frequent increase in leucocyte count, the only positive laboratory findings were cultures of *Staph. aureus hemolyticus* from the scalp furuncles and the subcutaneous abscess, and a predominance of *Staphylococcus aureus* in the throat culture. The possible exception is the report of *Staph. anhemolyticus* in the subculture of the first blood culture. In the light of subsequent events it seems probable that this was not a contamination as it was first considered. The child responded well to penicillin both times it was given.

COMMENT

1. It seems probable that this child had a staphylococcic blood stream infection. The negative cultures were probably due in part to chemotherapy used.

2. The inaccessibility of superficial veins led to repeated use of hypodermoclyses to maintain necessary fluid intake. Fluids given by this method included a solution of amino acids. It was in the area where this was given that subcutaneous abscesses developed. The same preparation and technique were, however, used on a few occasions with other patients without abscess formation. This fact, as well as the occurrence of fever before the use of the amino acid solution, makes it unlikely that the infection was introduced with its administration. It seems more probable that the blood stream infection led to abscess formation at sites of lowered tissue resistance due to the tissue trauma produced by clysis. There is also a possibility that the amino acid solution pooled in this area acted as a local culture medium.

3. The first course of penicillin was discontinued when local furunculosis subsided, even though some elevation of temperature persisted. This was chiefly due to difficulty in obtaining sufficient penicillin. More persistent and more intensive use of penicillin in the first instance might have prevented the subsequent developments.

PENICILLIN THERAPY IN RATBITE FEVER

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IT IS now fairly well established that fever following ratbite may be caused by either of two etiologic agents:

1. Sodoku, the spirillar form, or
2. the streptobacillary form caused by *streptobacillus moniliformis* (*Haverhillia multiformis* or *Streptothrix muris ratti*).

Sodoku, the endemic, Japanese or Oriental form is produced only by the bite of a rat or other animal. On the other hand, *S. moniliformis* septicemia is caused by a ratbite but also follows the ingestion of contaminated food. The latter disease has been called Haverhill fever.

Brown and Nunemaker[1] in an excellent article have presented a comparative clinical analysis of these two types and concluded that it is very difficult to draw sharp lines of differentiation between the streptobacillary and the spirochetal forms of ratbite fever by means of clinical observation. However, certain features of both syndromes are worth mentioning.

The clinical picture of ratbite fever due to the *Spirillum minus* (sodoku) is as follows: After an incubation period of about one to three weeks there is an exacerbation of the original wound with development of local swelling, pain, and purplish red discoloration. A chancrelike ulcer develops. Regional lymphangitis and lymphadenitis are present. There is frequently a macular or papular cutaneous rash which may be generalized but is often restricted to the area about the wound. The fever is of a remittent or intermittent type, and there may occur afebrile periods of three to nine days followed by another cycle of pyrexia. Arthritis is usually absent. The laboratory findings are polymorphonuclear leucocytosis, a secondary anemia, a usually negative blood Wassermann but a frequently positive Kahn reaction. The blood cultures are negative. The spirochetes can be visualized by dark-field examination of the fluids from the local lesions or from infected lymph gland material. For unmistakable diagnosis of the disease, intraperitoneal inoculation into white mice or guinea pigs is required with repeated study of blood, inguinal glands, and peritoneal exudate of these animals. Arsenicals in their various forms have been the treatment of choice for sodoku. The therapeutic dose is identical with that commonly employed in antisyphilitic treatments. The response is very good with abrupt cessation of fever and symptoms.

On the other hand, ratbite fever due to the *S. moniliformis* is characterized by a short incubation period of about three to six days. Ordinarily the patient has chills and fever, vomiting and headache. There is an early fine maculo-

From the Children's Medical Center and the Department of Pediatrics of Southwestern Medical College.

papular morbilliform or petechial rash. Arthritis is typically present, frequently multiple and with no definite joint predilection. The fever may be relapsing or remittent or septic in type. The serologic tests for syphilis as a rule are negative. The white cell count is usually elevated. For definite diagnosis of the disease, the *S. moniliformis* has to be isolated from blood or joint fluid. The reports regarding methods for the cultivation and study of the streptobacillus are contradictory. Brown and Nunemaker emphasize that when routine methods fail special media and techniques should be used. They state that serum from patients will agglutinate a polyvalent antigen of the streptobacillus in dilution of 1:50 and over. So far as the treatment is concerned, there is no response to arsenicals, and the use of sulfonamides has been disappointing.

We had the opportunity of observing a case of ratbite fever due to streptobacillus moniliformis in an 18-month-old girl. This child was treated with penicillin, and the therapeutic response to this treatment was prompt and permanent.

CASE REPORT

S. N., a white girl aged 18 months, was admitted to Bradford Memorial Hospital on Sept. 28, 1944, with a history of having been bitten by a rat on one toe six days previously. Within three days she developed high fever (103 to 104° F.) with a chill and a rash on arms and face similar to measles. The site of the ratbite became smaller and purplish discoloration spread up the foot. The patient was put on sulfonamide drugs for two days without effect. Antipyretics were used, and the temperature returned to normal for one day. Then the mother noticed pain in the child's shoulder when she was lifted. Because of the return of fever, the persistence of the rash, and the development of increased somnolence, the patient was sent to Bradford Hospital.

At the time of admission the child was acutely ill and her temperature was 104.8° F. by rectum. There was a macular pink rash distributed generally over her body covering the extremities including the palms of the hands and the soles of the feet, less prominent on chest, abdomen, and back. On the right second toe there was a ragged, secondarily infected laceration with moderate edema. Regional lymphangitis or lymphadenitis and no generalized lymphadenopathy were not present. The liver was palpable 1 cm. and the spleen 3 cm. below the costal margin.

The white blood cell count was 14,650 per cubic millimeter with 73 per cent polymorphonuclears and 26 per cent lymphocytes. The Kline test, the urinalysis, and the agglutination tests for typhoid, paratyphoid A and B, *Bacillus abortus* and *Bacillus proteus* X_{19} were all negative. The dark-field examination failed to reveal spirochetes. The first blood culture was also negative.

The patient was treated symptomatically for the fever which was of a septic type until on the fourth hospital day Dr. G. Fashena found in another blood culture gram-negative pleomorphic rods which, because of the morphologic and growth characteristics, he identified as *Haverhillia multiformis*. The microorganisms were further studied by Dr. Pike of the Bacteriological Department of Southwestern Medical College.

Immediately after the diagnosis was established, penicillin treatment was started with 5,000 units intramuscularly every three hours. On the next day the temperature dropped to normal and remained normal until discharge. The rash disappeared, and the wound on the toe healed within the following four days. All blood cultures after the start of penicillin treatment were negative. The child suffered no relapse and was discharged in good condition on the eleventh hospital day after a total of 225,000 units of penicillin had been given. Follow-up observations have shown that she has had no recurrence (Fig. 1).

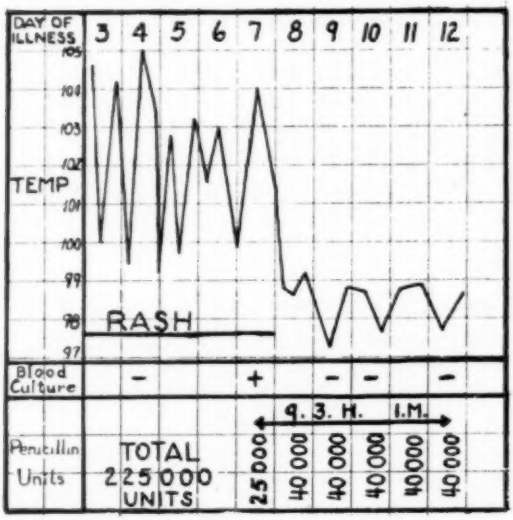

Fig. 1.—Course in case of ratbite fever due to *Streptobacillus moniliformis*.

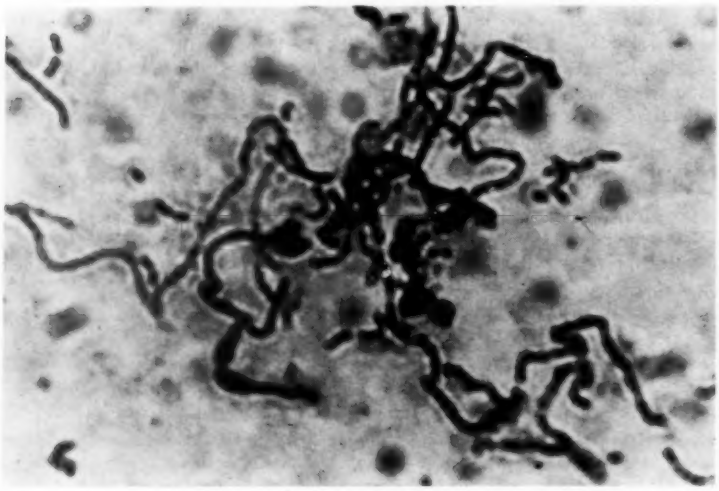

Fig. 2.—*Streptobacillus moniliformis* in a case of ratbite fever.

COMMENT

This case of streptobacillary type of ratbite fever showed a prompt and dramatic therapeutic response to the administration of penicillin. Normal temperature after a septic type of fever, definite improvement in the general condition, disappearance of the rash, and sterilization of the bloodstream were obtained within twenty-four hours of treatment. The organisms isolated by Dr. Gladys Fashena, Director of the Laboratory of the Children's Medical Center, were typical with respect to cultural and morphologic characteristics (Fig. 2). The susceptibility of the culture in serum infusion broth was tested by R. M. Pike at the Department of Bacteriology of Southwestern Medical College and showed inhibition of growth by about 0.1 Oxford units of penicillin (Table I).

TABLE I

UNITS OF PENICILLIN PER C.C. OF BROTH MEDIUMS	GROWTH OF STRAIN
50.00	−
25.00	−
10.00	−
5.00	−
1.00	−
0.50	−
0.10	−
0.05	+
0.00 (control)	++++

The very same results were obtained lately clinically and in vitro by Altemeier, Snyder, and Howe.[2] They summarized the salient features of all reported cases of ratbite fever in the United States in which the diagnosis was verified by recovery of *S. moniliformis* from the blood or joint fluid. They found only seventeen proved cases up to and including 1943, to which they added three of their own cases. They, too, treated their patients with penicillin and they like we, had the impression that penicillin is a very effective chemotherapeutic agent in ratbite fever due to S. *moniliformis*.

In the recent report prepared by Dr. Chester S. Keefer, representing the recommendations of the Office of Scientific Research and Development and the National Research Council, ratbite fever due to *S. moniliformis* is listed among the diseases in which penicillin is of questionable value. In consideration of the experiments done by Heilman and Herrell[3] at the Mayo Clinic (they subjected eighty-six mice to infection by *S. moniliformis* and obtained 98 per cent mortality in the untreated animals and a 100 per cent survival in the penicillin treated group) and with regard to the results obtained by Altemeier and associates and our own experience, ratbite fever should be listed among the diseases for which penicillin is the best therapeutic agent available. It promptly sterilizes the blood stream and shortens decidedly the course of the disease.

SUMMARY

1. The two separate forms of ratbite fever are briefly reviewed.

2. A case of *S. moniliformis* septicemia following ratbite in an 18-month-old child is presented with clinical and laboratory findings.

3. This patient showed a prompt and permanent therapeutic response to penicillin.

4. In vitro the strain of *S. moniliformis* recovered was definitely susceptible to the bacteriostatic effect of penicillin.

5. Penicillin is recommended as the treatment of choice in ratbite and Haverhill fevers.

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3403 HALL STREET

PENICILLIN LOCALLY IN THE EYES OF NEWBORN INFANTS TO PREVENT OPHTHALMIA NEONATORUM

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OPHTHALMIA neonatorum continues to occur[1] in spite of the use of silver salts as the prophylactic agent in the present Credé method for prevention. The need for a specific substance that will give a higher incidence of protection is most pressing.

In one of the nurseries of a large obstetrical hospital in Houston, Texas, there recently developed a case of gonorrheal ophthalmia neonatorum. As soon as the conjunctivitis developed, the infant was isolated, but it was believed that some of the other twenty infants in the nursery might have been exposed. Accordingly, the nursery was closed and penicillin was ordered used locally in the eyes of each infant. Four drops of penicillin (250 units per cubic centimeter) were instilled in each eye every four hours.

Of the twenty infants, nine male and eleven female infants, one female infant the following day developed a conjunctivitis in one eye. Smears from that eye showed no organisms, and the discharge cleared in three days with no further treatment than boric acid irrigations. Inasmuch as the conjunctivitis, discharge, and swelling was limited to one eye, it was believed that penicillin had no part in causing the conjunctivitis, but that the conjunctivitis was the start of an ophthalmia neonatorum that had been so depressed that the infant was able to clear the infection. The eyes of all the other infants showed no secretion or any evidence of irritation after the use of penicillin.

Struble and Bellows[2] state that infections involving conjunctiva and cornea respond rapidly to penicillin locally, and that clinical results of local application of penicillin in external ocular disease are encouraging.

SUMMARY AND COMMENT

An additional case of gonorrheal ophthalmic neonatorum has developed after the use of a silver preparation in the Credé method of prevention. The treatment with penicillin in a nursery of twenty infants having a possible exposure to this gonorrheal conjunctivitis resulted in no further spread of the infection in the nursery. The results suggests that penicillin locally can and should be used as a specific prophylactic agent in the Credé method of prevention of ophthalmia neonatorum.

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UNUSUAL FULMINATING GENERALIZED STAPHYLOCOCCUS INFECTIONS TREATED WITH PENICILLIN

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DURHAM, N. C.

CASE 1.—A 5-week-old white male, one of twins, born at home, weighing 7 pounds, was breast fed and did well until 2 weeks of age when he developed a respiratory infection. He then refused feedings and was placed on an evaporated milk formula. He continued to have fever, and one week prior to admission developed diarrhea, a distended abdomen, and became progressively weaker.

When seen at Duke Hospital on Jan. 6, 1945, he was an acutely ill child, having a fever of 39° C. (102.2° F.), a loose, greenish, watery diarrhea, and a large, tense, reddishly tinted abdomen. On physical examination he weighed 3,400 Gm. (7½ pounds), had a red throat, and a dry skin, which was shiny and atrophic over the large abdomen; the latter was tense, painful, and an angry deep red in color. The liver was very greatly enlarged and filled all except the left lower quadrant of the abdomen. The lower rib margin was flared due to the pressure exerted by the large liver mass. The spleen could not be felt. The perineal region revealed weight-loss and irritation of the skin.

Course in Hospital.—He was given as much saline by mouth as he would tolerate, and sulfapyrazine 0.2 Gm. per kilogram of body-weight for a twenty-four-hour period, following an initial dose of 0.5 Gm., subcutaneously. Blood, throat, and stool cultures contained hemolytic *Staphylococcus aureus*, so the child was also given 2,000 units of penicillin every two hours subcutaneously for fourteen days in addition to the stated sulfatherapy. The tuberculin and serologic tests for syphilis were negative. The urine contained a few white blood cells and red blood cells. The hemoglobin was 11.2 Gm. (70 per cent) and the white count 14,600 with a differential of 57 segmented cells, 17 stabs, 2 juveniles, 2 large lymphocytes, 19 small lymphocytes, 2 monocytes. The carbon dioxide combining power was 35 volumes per cent. He was given numerous transfusions with blood and plasma and large amounts of staphylococcus antitoxin, but he continued to go downhill during this two-week period. His skin became jaundiced, a bleeding tendency developed, and abscesses appeared on the anterior abdominal wall overlying the enlarged liver. His fever remained high and his condition was poor. However, he was taking a Casec, evaporated milk formula fairly well with little diarrhea. The cephalin flocculation was 4 plus, the van den Bergh was direct with a bilirubin of 2.5 mg. per 100 c.c. He was given menadione daily and all the supplemental vitamins. The blood, throat, and stool cultures became negative after the tenth day, but those of the abscesses on the abdominal wall and of the peritoneal fluid were still positive for hemolytic *Staph. aureus*.

Three abscesses in the epigastric region were opened widely and were found to communicate with the liver. Rubber drains were inserted and moist compresses were applied. The child was then given penicillin 250 units per cubic centimeter in saline by continuous intramuscular drip. A number 20 infusion needle was used and a transfusion set with a drip. The needle was placed deep in the quadriceps femoris muscle and withdrawn and placed in the opposite thigh on alternate days. A total of 500,000 units of penicillin was thus administered in five days.

The condition of the child improved following this therapy. Sulfapyrazine was continued another two weeks or a total of six weeks. He lost weight immediately following his intensive intramuscular penicillin therapy and his abdomen grew smaller and softer. The abscesses healed rapidly, the bleeding time returned to normal, and after the fourth week he began to gain weight and strength. On his forty-fourth hospital day he was dis-

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DATE	PARENTERAL FLUIDS	DRUG THERAPY			Hgb%	WBC	Cultures			
		Sulfapyrazine	Penicillin 2000u q2h	Penicillin I.M. drip			Blood	Stool	Throat	Abscesses
1-7	1/6 molar lactate 200cc	↓	↓	↓	70	196	+	+	+	
1-8	5% dextrose 100cc i.v.				72	186	+	+	+	
1-9	Plasma 100cc				75	18	−	−	−	
1-10	100,000u Staph. antitoxin Plasma 100cc				65		−			
1-14					60	20				
1-15					49					
1-19	Blood 60cc									+
1-22	Blood 70cc				59	144				+
1-24	Blood 120cc		↓		74	124				+
1-26	Blood 70cc			↓	78	108				
1-30					80	12.				
2-5					73	82	−			−
2-7		↓			76	86				
2-11					75	92				HEALED
2-16					78	86				↓
	DISCHARGED									

Chart I.—Case 1.

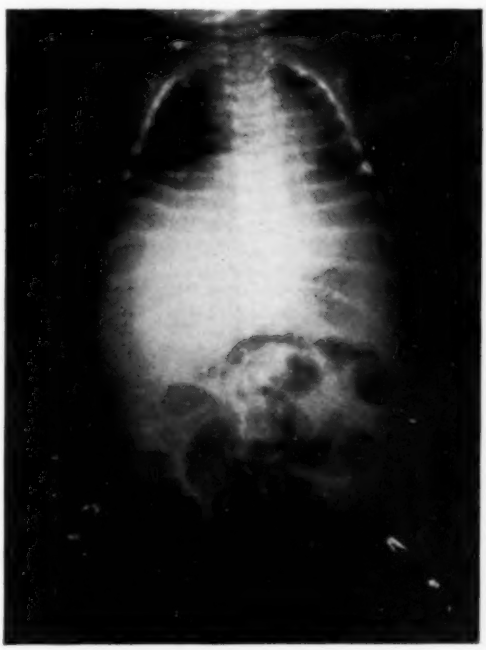

Fig. 1.—X-ray of abdomen on third hospital day.

charged, the liver was still quite large, but all jaundice had disappeared. Chart I outlines the therapy carried out on this infant during his hospital course.

The patient has been seen in our outpatient clinic at intervals of one and three months following his discharge. His liver is no longer enlarged and he shows no stigmata of disease. He weighs 6,740 Gm. (14½ pounds) at 6 months and has normal van den Bergh, Weltmann, cephalin flocculations, and serum protein studies. We have seen no cases similar to this with recovery in Duke Hospital, and it will be of interest to follow this child who had severe liver damage and to ascertain the impairment of liver function of patients who live because of improved drug therapy. Our experience with this case seems to indicate that in rare instances when the ordinary injections of penicillin do not obtain a satisfactory response, continuous intramuscular drip penicillin is advisable in the treatment of small infants.

CASE 2.—A 6-year-old Negro boy with congenital ptosis of the right eyelid was in good health until six days before admission when he complained of itching in his right eye. A slight swelling was noted about the eye, and the next morning his eye was worse. He was taken to his physician who lanced a boil on the lower lid and advised compressing the eye with saline compresses. However, the swelling and pain increased about the eye and he developed fever and chills. The day before admission the left eye began to swell, he complained of pain in his neck and became critically ill.

DATE	PARENTERAL FLUIDS	DRUG THERAPY		Hg. b %	W B C	CULTURES (*Hemolytic Staph aureus*)				
						Blood	Conjunctiva	Urine	Stool	Spinal fluid
10-1-44	10,000u. penicillin intra spinal 40,000u. Staph. antitoxin	Sulfadiazine 0.5 gm. q 4h.	Penicillin 10,000u. q 2h.	72	36.8	+	+	+	+	+
10-2	20,000u. Staph. antitoxin			65	39.1	+	+			
10-4	20,000u. Staph. antitoxin 500cc. 5% dextrose i.v.			60	44.3	+	+			+
10-6	250 c.c. Blood Abscess on foot aspirated			80	25.4	+	+	–	–	
10-7	300 c.c. Blood			82	28.7		–			+
10-9			5,000u. q 2h.	87	19.2	–				
10-12				90	22.0	–	–			–
10-14				85	18.5	–				–
10-16				82	14.6	–				
10-20				83	12.2	–				
10-22				80	10.3					
10-23	Discharged									

Chart II.—Case 2.

On admission to the hospital he was a drowsy, irrational boy with a fever of 40° C. (104° F.), marked bilateral periorbital edema, and exophthalmos. He had a large amount of bloody purulent discharge about the eyes and nose. The veins on the forehead and eyelids were very prominent, and the central retinal veins seemed engorged; the vision was grossly normal. The neck was stiff and painful on motion, and the back was questionably stiff. A lumbar puncture was performed. The initial opening pressure was 160 mm. of water, the cell count was 350, 90 per cent being polymorphonuclear cells. No organisms were seen on the smear of the spinal fluid. The hemoglobin was 78 per cent, red blood cells 4,400,000; white blood cells, 36,800 and a Schilling hemogram of 20 per cent segmented

Fig. 2.—Photographs on second hospital day.

Fig. 3.—Photographs on discharge.

cells, 58 per cent stabs, 13 juveniles, 9 small lymphocytes. The stool contained blood and was loose and green in color. The urine contained 20 red blood cells per high power field.

He was thought to have a cavernous sinus thrombosis, septicemia, and meningitis, and since a direct smear of the pus about the eyes and nose revealed staphylococci, he was given intensive sulfonamide, penicillin, and staphylococcus antitoxin therapy. Cultures of the blood, conjunctivae, spinal fluid, urine and stool were positive for a hemolytic *Staph. aureus*, 20 colonies per c.c. being found in the blood culture. He was given 10,000 units of penicillin intrathecally on the first day, and 5,000 units on two successive days. We have since learned, as Johnson and Walker[1] have warned, that penicillin should not be given intraspinally. Cultures of the spinal fluid, however, remained positive for hemolytic *Staph. aureus* until his tenth day of treatment.

A soft tissue abscess of large size developed over the dorsum of his left foot. This was drained by aspiration, and 10,000 units of penicillin were injected into the cavity. X-ray showed no bony involvement, and this abscess rapidly resolved and healed. Hemolytic *Staph. aureus* was grown from the 60 c.c. of pus removed. It was necessary to give him two blood transfusions as his hemoglobin fell rapidly following admission. His diet and fluids were maintained, and local applications of boric acid were made to the involved eyes. Chart II outlines the treatment program of his hospital stay.

His fever remained septic for five days and then returned to normal. His eyes were much improved by his tenth hospital day, and subjectively he appeared well. From then on he was watched and continued on penicillin and sulfonamides until his white blood count had returned to normal, and then discharged with no residual stigmata of his disease. The final diagnosis was hemolytic *Staph. aureus* cavernous sinus thrombosis, septicemia, enteritis, meningitis, and pyelitis.

In conclusion we feel that this patient would have died without the adjuvant therapy of penicillin with his other treatment, and all other sources of therapy should be used intensively.

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THE PROGNOSIS IN ACUTE GLOMERULONEPHRITIS IN CHILDREN

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IN 1937 Snoke[1] published a study on the prognosis of glomerulonephritis in children based on the 178 cases observed in San Francisco between 1920 and 1936, in which the Addis method of urinary analysis had been used. Of the 178, 154 patients had been followed (by 1936) for some time after the diagnosis had been established and in these only fifty-seven, or 37 per cent, had healed; thirty-three, or 21 per cent, were dead, and 64, or 42 per cent, still had evidences of active renal disease. These, it is to be noted, were gross figures for all children admitted during any stage of glomerulonephritis. An analysis of the data according to the stage of the disease at the time of its discovery and according to its duration when the study was made, showed only a slightly favorable prognosis for those cases in which the occurrence and time of onset of the initial stage ("acute glomerulonephritis") were known from the history. Of these there were ninety-eight cases, in which healing had already occurred in thirty-eight (39 per cent); the condition was still active in fifty-two (53 per cent); and death had occurred in eight (8 per cent). However, of the fifty-two still active, twenty-five (26 per cent) were still within the two-year period after onset beyond which recovery is very rare, and therefore had some chance of eventual recovery. Omitting these last for comparison with our figures, seventy-three patients were left of whom 52 per cent had recovered completely, 37 per cent were chronic with little chance of healing, and 11 per cent had died.

These figures, however, still stand at sharp variance from most of those elsewhere reported and have probably not received general acceptance as representing accurately the outlook in glomerulonephritis in childhood.

Since the original material on which Snoke based his study is still available to us and since we have added a number of cases to it after his review was completed, it seemed desirable for us to re-evaluate the data. For this purpose we have excluded all cases *excepting those in which the patient was seen here during the initial stage of the disease.* We have thus eliminated the factors of selection and weighting inherent in the original study from the fact that many of the patients were already in advanced stages of nephritis when first seen here, and indeed had frequently been referred to us because they had not recovered, while undoubtedly patients who had recovered after the initial stage elsewhere were but rarely referred to us. We have also omitted cases in which present activity has lasted less than two years and in which the outcome is still in doubt. For the following tabulation, the period of observation is 1920 to 1941 and the

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*The compilation of material for this paper was completed in 1941 before Captain Davis entered military service.

number of cases is 102, of which 82 were in the material compiled by Snoke and the remaining 20 have been collected since then. All of them have been followed adequately; that is, to the time of healing, death or, in the case of continuing activity, for at least two years. The results are shown in Table I.

TABLE I. OUTCOME IN ONE HUNDRED TWO CASES OF ACUTE GLOMERULONEPHRITIS

Healed	83	or	81.3%
Still active (over 2 years)	8	or	7.8%
Dead	11	or	10.8%
Of acute nephritis	6	or	5.9%
Of chronic nephritis	5	or	4.9%

The analysis may be further refined by excluding the six cases in which death occurred during the acute stage, leaving figures which would apply to the prognosis of acute glomerulonephritis after the danger period of the initial attack had elapsed. These are shown in Table II.

TABLE II. OUTCOME IN NINETY-SIX CASES OF ACUTE GLOMERULONEPHRITIS SURVIVING THE INITIAL STAGE

Healed	83	or	86.5%
Still active (over 2 years)	8	or	8.3%
Dead (of chronic nephritis)	5	or	5.2%

DISCUSSION

The difference in prognosis between that expressed by our analysis and that by Snoke's[1]—86 per cent of healing as compared with thirty-seven, 52 per cent—confirms our suspicion that Snoke's figures were heavily weighted by the inclusion of considerable numbers of cases referred after the development of chronic disease to a center widely known to be interested in the problems of Bright's disease. Such selection inevitably excludes a still larger number of cases which ended in healing and were never referred. It is noteworthy that the data of Cass,[2] apparently based on a similar selection of cases, afford prognostic figures for children not dissimilar to those of Snoke. Curiously, Snoke's data from Rochester, N.Y.,[3] when analyzed like ours in terms of healing, activity for over two years and deaths in the acute and chronic stage, give results almost the same as ours, as is shown in Tables III and IV; we can only

TABLE III. OUTCOME IN SNOKE'S CASES FROM ROCHESTER, N. Y.

Healed	76	or	81.8%
Still active (over 2 years)	9	or	9.7%
Dead*	8	or	8.6%
Of acute nephritis	6	or	6.5%
Of chronic nephritis	2	or	2.1%
Total	93		

*Four cases omitted with death from other causes.

TABLE IV. OUTCOME IN THOSE SURVIVING THE INITIAL STAGE

Healed	76	or	87.4%
Still active (over 2 years)	9	or	10.3%
Dead (of chronic nephritis)	2	or	2.3%
Total	87		

suggest that these may have been cases mainly in the initial stage at the time of admission to the hospital service.

In comparison with other studies the present figures show a good agreement with some and a poorer one with others. Thus, our figures agree fairly well with the early study of Lyttle and Rosenberg[4] from New York City (79 per cent cured and 11 per cent became chronic); with those of Kohn[5] from New York City (85 per cent recovered completely); with those of Gachet[6] from Rochester, N. Y. (90.5 per cent recovered completely of those surviving the initial attack); but not with Lyttle's[7] later figures (only 2 cases becoming chronic out of a total of 144 acute cases); nor with those of Pittinos, Craig, and DeSanctis[8] from New York City (one possible latent case in 32 recalled for Addis counts); nor with Aldrich's[9] experience in Chicago that all patients surviving the initial attack completely recover. For these divergences we have no wholly satisfactory explanation, but we suspect that they are due in part to differences in definition and classification of acute glomerulonephritis and in part to the failure to employ routinely and repeatedly a method (Addis technique) which can be depended upon to reveal the minimal evidences of continuing activity. Our own experience convinces us that a fairly large number of cases of acute and latent nephritis will be missed if this is not done, and that the correct prognosis cannot otherwise be established in individual cases.

We seriously question whether geographical differences exist in respect to the gravity and prognosis of glomerulonephritis in children.

SUMMARY

1. Of 102 children observed in this institution during the initial stage of glomerulonephritis and for adequate periods thereafter, approximately 81 per cent fully recovered; 11 per cent died and 8 per cent still showed activity for two years or more after the onset, when the chances of recovery had become negligible. Six per cent died during the initial stage, and 5 per cent died later of chronic nephritis.

2. Of those surviving the initial stage 86.5 per cent were cured; 8.3 per cent had remained active for more than two years, and 5.2 per cent died of chronic nephritis.

3. The differences in prognosis expressed by our data and by those of others are discussed.

4. We question the existence of geographical differences in prognosis.

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SURGICAL TREATMENT OF CONGENITAL ATRESIA OF THE ESOPHAGUS

With a Report of Four Cases

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UNTIL very recently, the outlook for the child born with an obstructive defect in the esophagus was hopeless. When Vogt[1] classified the anomalies in 1929, he stated, "Congenital esophageal atresia has up to the present been 100 per cent fatal." However, he expressed the hope that some ingenious surgeon would eventually devise a cure, since the majority of these infants are entirely normal in other respects. Ten years later, Leven[2] was able to report that a child had survived the serious preliminary operations of a multiple stage procedure and if an antethoracic skin tube could be constructed, the case could be called successful. The indirect method used by Leven and others had many disadvantages and it was soon to give way to the operation of direct anastomosis described by Shaw[3] and first successfully carried out by Haight and Towsley.[4] The literature previous to this report contains accounts of fourteen babies who are alive after the multiple stage operations and eleven who survived the direct procedure. (Tables I and II.) It is the purpose of this communication to add one case to the former group and two to the latter and to record one unsuccessful case. It is desired to call attention to the changed prognosis in the condition if a prompt diagnosis is made and the proper surgical measures are carried out.

Vogt[1] classified the atresias as follows: Type 1, in which there is complete absence of the esophagus (rare); Type 2, in which there is an upper and a lower segment ending in blind pouches (also rare); Type 3, in which one or both of the segments communicate with the trachea or bronchus. This type is subdivided into Type 3(a), in which the fistula is between the upper segment and the trachea, Type 3(b), in which the fistula is between the lower segment and the trachea; and Type 3(c), in which both segments communicate. Type 3(b) (Fig. 1) is encountered more frequently than all the others combined; in fact, it probably accounts for from 80 to 90 per cent of all congenital atresias of the esophagus.

If a newborn infant has a tendency to choke on his own mucus or is unable to take feedings, suitable roentgen studies should be carried out and if a congenital lesion is present, its type can be determined with considerable certainty. The film illustrated in Fig. 2 shows a blind upper segment outlined with iodized oil and an air-containing stomach. The latter finding proves the patency of the lower segment and indicates that the defect is of the Type 3(b).

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TABLE I. ANALYSIS OF PATIENTS SURVIVING INDIRECT METHOD (MEDIASTINAL LIGATION, CERVICAL ESOPHAGOSTOMY, GASTROSTOMY AND ANTETHORACIC SKIN TUBE)

SURGEON	OPERATIONS	PATIENTS ALIVE	ESOPHAGUS COMPLETED
Leven[2]	3	1*	–
Ladd[6]	22	9	2
Nettrour[7]	1	1	–
Humphreys[8]	6	1	–
Lam	2	1	–
	34	15	2

*In a discussion of Haight's paper[9] at the meeting of the American Surgical Association on May 4, 1944, Leven[5] stated that he had five patients alive. Since he did not give the total number of operations, the additional four patients were omitted from this tabulation.

TABLE II. ANALYSIS OF SURVIVING PATIENTS, DIRECT METHOD (EXTRAPLEURAL ANASTAMOSIS)

SURGEON	OPERATIONS	PATIENTS ALIVE
Shaw[3, 9]	2	1
Haight[9]	16	6
Ladd[6]	3	1
Gross[6]	4	1
Daniel[10]	3	1
Humphreys[8]	6	1
Lam	2	2
	36	13

If no air is seen in the stomach, Type 2 is suggested. If some of the oil is observed to pass directly from the upper segment into the trachea, Type 3(a) (no air in stomach) or Type 3(c) would be indicated.

Consideration of the defect shown in Fig. 1 makes it evident that it is necessary for an operation or series of operations to accomplish three objectives in order to be successful. (1) Provision must be made for feeding the infant. (2) Regurgitation from the stomach through the lower segment into the trachea and bronchial tree must be prevented. (3) The blind pouch of the upper segment must be opened to allow the escape of swallowed saliva. These requirements would be met by gastrostomy, ligation of the lower esophageal segment, and marsupialization of the upper pouch. With these three procedures completed, the situation would be compatible with life, but permanent gastrostomy feedings would be necessary unless an antethoracic esophagus could be constructed. On the other hand, the operation of direct anastomosis meets at once all of the essentials for the establishment of normal functional and anatomic conditions.

The operative technique used in the last two of the three cases herein reported was essentially that described by Shaw[3] and Haight.[9] Most or all of the operation is performed under local anesthesia (0.5 per cent procaine solution). A transfusion of approximately 75 c.c. of blood is given through a cannula inserted in an ankle vein. Access to the posterior mediastinum is gained by exposure of the vertebral ends of the second through the sixth ribs, subperiosteal resection of short lengths of these ribs, section of the third, fourth, and fifth intercostal bundles and careful reflection of the parietal pleura from the vertebral column. It is necessary to ligate the azygos vein on the right or

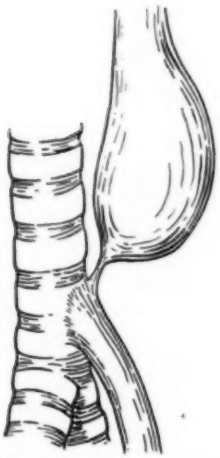

Fig. 1.—Semidiagrammatic illustration of the common type of atresia of the esophagus, Type 3(b) of Vogt.

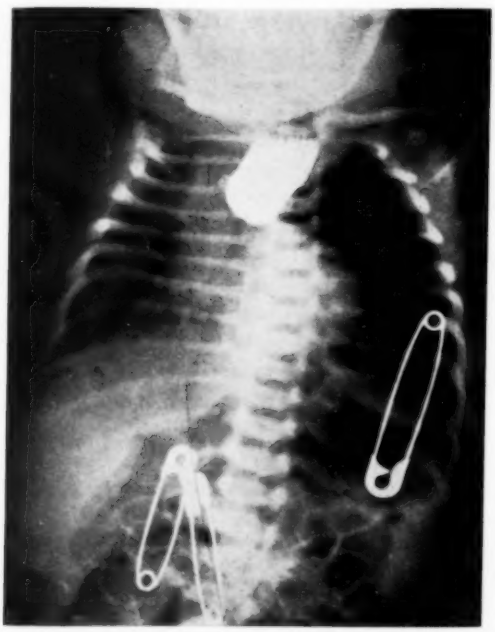

Fig. 2.—Preoperative roentgenogram (Case 2). Iodized oil has been placed in the blind proximal segment. Note the air in the stomach, indicating that the lower segment connects with the trachea. The shift of the heart and mediastinum to the right is due to atelectasis.

the upper two or three intercostal arteries on the left to open up the space behind the trachea where search will be made for the distal segment. The upper segment is identified by the palpation of a catheter which has been introduced through the mouth. The lower segment is then located and ligated as close to the trachea as possible. It is cut transversely distal to the ligature and a corresponding opening is made in the blind upper segment. End-to-end anastomosis is performed over a catheter, using fine silk in dural or eye needles (Fig. 3). Needless to say, every attempt is made to obtain a leak-proof anastomosis without undue tension on the suture line. Every surgeon who has published reports of living cases has utilized a slightly different method of making the anastomosis. If no distal segment can be found or, if after ligation, the segment is too short to be connected with the upper one, the original plan will have to be abandoned in favor of an indirect method such as that described in connection with Cases 1 and 4. After the anastomosis is completed, a small amount of penicillin (e.g. 30,000 units) may be put in the mediastinum, after which the chest wall is closed about a small drain.

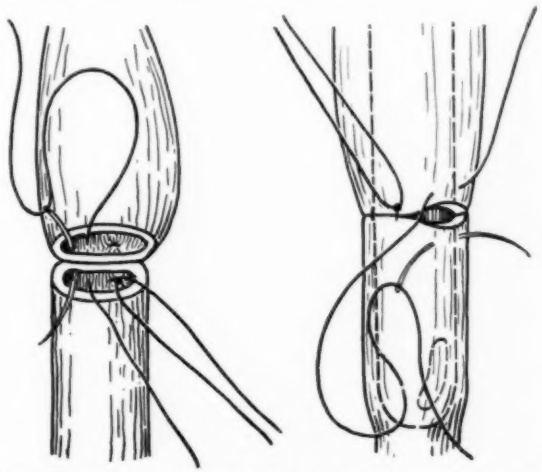

Fig. 3.—Details of procedure of anastomosis after cutting of lower segment from trachea and opening of upper segment. The catheter is removed when the operation is finished.

The immediate postoperative care is important. The infants reported here were placed in an oxygen tent-incubator at once. There must be extreme vigilance in the aspiration of secretions from the pharynx if there is any tendency toward accumulation. Nothing is given by mouth for five days, parenteral fluids being administered by hypodermoclysis. Care must be taken that too much fluid is not given; 250 c.c. per day is probably enough and most of this should be 5 per cent dextrose. Several cases have been reported where the chief factor in the fatal issue appears to have been an excess of parenteral fluid.[4, 11] On the fifth day, if inspection of the dressing shows no leakage of mucus from the wound, cautious feeding by mouth is begun. One-half an ounce of 5 per

cent dextrose solution is offered every two hours. If there is no regurgitation or evidence that the anastomosis is not intact, this amount is gradually increased to two ounces. On the seventh postoperative day, one ounce of formula is given every two hours. If this is tolerated, all restrictions on the feeding of formula are removed after the tenth day. Vomiting should be avoided for it would undoubtedly put strain on the anastomosis.

Although the procedure used in Case 1 of this series is now thought to be less desirable than the direct method employed with the other two infants, the case will be reported for historical reasons and because it illustrates an alternative line of attack in case anastomosis is not possible, as in Case 4.

CASE 1.—T. R., a boy, was born at the Henry Ford Hospital on Aug. 1, 1943. When the child was 2 days old, Dr. Douglas Wake, resident on the pediatric service of Dr. J. A. Johnston, wrote the following note: "The baby has been salivating profusely since birth and has not been able to take more than two or three swallows of formula without cyanosis. This is suggestive of stenosis of the esophagus. If this is present, there is probably also a tracheo-esophageal fistula." Roentgen examination showed a picture very similar to that of Fig. 2. On account of the high mortality rate then associated with the operation of direct anastomosis, it was elected to do a multiple stage procedure. On Aug. 4, 1943, the stomach was transected as near the esophagus as possible and mushroom catheters were placed in each of the two parts of the stomach. The proximal one was used to drain the lower esophageal segment and the distal one was used for feeding. Special nurses kept the pharnyx free of mucus until the second stage was done on Aug. 18, 1943. The upper segment was mobilized through a cervical incision and brought out through a stab wound on the chest wall below the clavicle. It was opened immediately to allow the escape of saliva. On Jan. 21, 1944, the child coughed up a small portion of gastrostomy feeding and it was obvious that a fistula had formed between the two parts of the stomach. Three days later, an intrapleural ligation and division of the distal segment was done, the end being brought out under the diaphragm on the left lateral abdominal wall. On Feb. 11, 1944, both gastrostomies were closed and the continuity of the stomach was re-established. Feeding was conveniently done by the intermittent insertion of a catheter into the abdominal esophagostomy.

When the child was a year old, the lower esophagostomy was moved from the lateral abdominal wall to a point as high as possible in the midline of the chest. Thus, the two esophagostomies were only about five inches apart. Plastic procedures to construct a connecting skin tube were begun. As was expected, disappointments were encountered and at the time of this report, the tube is not entirely finished. However, the child is in a normal state of nutrition and development and it is assumed that subsequently it can be reported that the procedure has been carried to a successful conclusion.

The experience with Case 1 was such that when there was opportunity to operate on two other patients, the direct procedure was chosen.

CASE 2.—L. T., boy, was born Nov. 11, 1944, in Woman's Hospital, Detroit. The birth weight was 7 pounds, 11 ounces. At first, the child appeared to be normal, but it was soon noted that he had more mucus than usual from his mouth. When attempts were made to feed him on November 12, all the formula was promptly thrown up along with a great deal of mucus and there was marked difficulty in breathing until efforts at feeding were discontinued. A catheter could not be inserted into the stomach. Dr. Ruth Kraft, pediatrician, was consulted and she suspected atresia of the esophagus. Roentgen examination showed the catheter stopping at the level of the second thoracic vertebra and air in the gastrointestinal tract. The child was transferred to the Henry Ford Hospital on November 14, where the roentgenograms shown in Fig. 2 were made, using iodized oil. The operation of direct

anastomosis which I have described was carried out on Nov. 15, 1944, the mediastinum being entered from the left side. The operation presented no particular difficulties, except that a small tear was made in the apical pleura. The lungs were kept inflated by positive pressure applied with a small face mask. A small amount of ether was given during the suturing of the esophageal ends.

With the exception of one alarming cyanotic spell on the first night, the convalescence was uneventful. Rectal temperature was 104.6° F. on the first postoperative day and was normal after the third day. Regular formula feedings were taken eagerly after the tenth day. The child was discharged from the hospital on Dec. 6, 1944, weighing 6 pounds, 10 ounces. No difficulty with feeding was encountered in the home. Weight on December 23 was 7 pounds, 11 ounces, and on Jan. 27, 1945, it was 9 pounds, 12 ounces. On January 11, the photograph shown in Fig. 4 was made.

Fig. 4.—L. T. (Case 2), two months after operation.

CASE 3.—T. L., boy, was born at Woman's Hospital, Detroit, on Dec. 5, 1944. The birth weight was 7 pounds. The preoperative history is identical with that in Case 2. The diagnosis was made by the same pediatrician, with confirmation by a typical roentgenogram (Fig. 5). The infant was transferred to the Henry Ford Hospital on December 6, at a time when I was out of town on urgent business. Instructions were given over the long distance telephone regarding the importance of keeping the pharnyx dry by repeated aspirations. When the operation was done on December 9, the child was in perfect condition. The procedure was done entirely under local anesthesia, utilizing the approach from the right side of the thorax. The course following operation was very smooth. On the fifth day, a little iodized oil was placed in the mouth with a medicine dropper. This passed into the stomach so fast that the site of anastomosis could not be located fluoroscopically (Fig. 6). Weight at the time of discharge was 7 pounds, 3 ounces (Fig. 7). The infant was readmitted on Jan. 19, 1945, and kept under observation for one week because the mother reported an attack of respiratory difficulty with cyanosis. No such spell was noted during this period and all feedings were taken eagerly. On January 26, the weight was 8 pounds, 8 ounces (Fig. 8) and on March 1, it was 12 pounds.

CASE 4.—D. L., boy, was born at the Henry Ford Hospital on Feb. 28, 1945. The typical symptoms of atresia of the esophagus appeared, and the diagnosis was established by roentgen examination with iodized oil the next day. The upper pouch was very short, ending at the first thoracic vertebra. It was suspected that anastomosis would be difficult if not impossible. The mediastinum was explored from the right side on March 2. Both

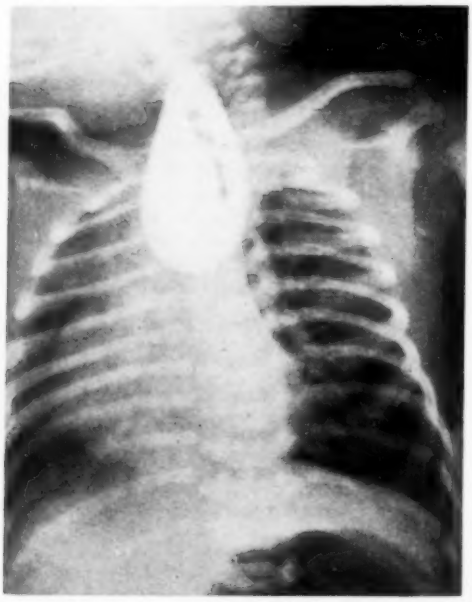

Fig. 5.—Preoperative roentgenogram of T. L. (Case 3).

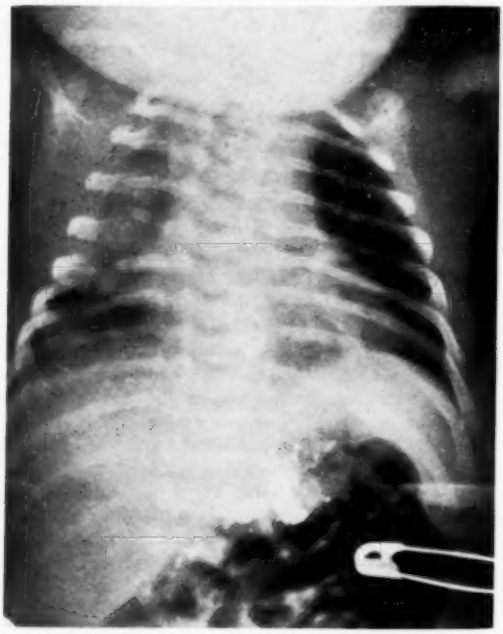

Fig. 6.—Postoperative roentgenogram taken five days after operation (Case 3). The iodized oil passed rapidly into the stomach. Note the operative defects in the ribs on the right.

Fig. 7.—T. L. (Case 3), four weeks after operation.

Fig. 8.—T. L. (Case 3), seven weeks after operation, showing the location and extent of the healed incision.

segments were located and the fistulous connection of the lower was ligated, but anastomosis could not be accomplished because of the very short length of the pouch. The incision was closed and it was planned to proceed with the multiple stage procedure in a few days. However, the condition of the child, which was poor at the end of the unsuccessful operation, became progressively worse and death occurred on the second postsoperative day. Autopsy showed that death was due to atelectasis and pneumonia.

SUMMARY

The infant with atresia of the esophagus no longer faces certain death but instead has a very good chance of surviving if the recently perfected surgical procedures are carried out. Three of the four reported here are alive and well. Including these, there is information concerning twenty-eight others who are living. Thirteen of these had the preferred operation of direct anastomosis.

The low mortality in this small series may be attributed in part to the fact that the three infants who survived were in excellent condition at the time of operation. Pneumonia from the aspiration of milk during persistent but futile attempts at feeding was prevented because a relatively early diagnosis was made in each case. It should be stressed that if the anomaly is suspected, barium should not be used to demonstrate it, since this contrast medium is very irritating to the bronchial mucosa. A small amount of iodized oil should be introduced through the catheter under fluoroscopic control and removed after the film has been made.

It should be noted that the operation for the repair of atresia of the esophagus is not necessarily an emergency operation. There was a delay of three days between the diagnosis and the procedure in Case 3 because of the absence of the thoracic surgeon. Even a two-week interval is not incompatible with a successful result.[12] Therefore, if the diagnosis is made reasonably early, there is ample time for an infant, accompanied by a physician or nurse, to be carried by modern methods of transportation from almost anywhere in the world to a surgical center where there is a chest surgeon who is interested in salvaging these lives.

ADDENDUM

Since this report was submitted for publication, two additional patients have been operated on and a direct anastomosis performed. One patient is alive and well at the age of 6 months; the other expired two weeks after the operation, with a recurrence of the tracheoesophageal fistula.

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ERYTHEMA EXUDATIVUM MULTIFORME (HEBRA)—BULLOUS TYPE

Cases Seen in a Contagious Disease Hospital

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THE bullous form of erythema exudativum multiforme (Hebra), called erythema multiforme bullosum, is not commonly seen in hospitals or private practice. We are presenting, primarily to the pediatricians, a brief description of erythema multiforme bullosum, and a report of sixteen cases seen at Willard Parker Hospital, the contagious disease hospital for New York City. We hope to emphasize the difficulties in differentiating this disease from the acute contagious diseases.

Erythema multiforme, also known as erythema exudativum multiforme or erythema polymorphe, is an acute inflammatory disease of the skin characterized by red to reddish-purple macules, papules, vesicles, tubercules, or iris lesions. Less commonly purpura, bullae, urticaria, or angioneurotic edema, alone or in combination, are also seen. The mucous membranes are often involved alone or in combination with the skin rash. The skin rash may be mildly pruritic or burning. It may be accompanied by one or more of the following: fever, vomiting, general malaise, headache, colic, melena, or arthritis. The bullous type is one of the unusual manifestations of this disease in which sufficient exudation occurs to produce vesicles and bullae. Usually this variety of the disease also involves the mucous membranes and in general is much more severe than the common varieties.

Clinically, the patients may be mildly to severely ill, with recovery in from two to five weeks in most instances. There may be recurrences. The prognosis depends more upon the severity of the constitutional symptoms than upon the severity of the skin rash. There is no known etiologic agent but some authors attribute it to an allergic reaction to drugs, food, or bacteria; still others believe it is of bacterial or viral origin.

The pathologic lesion is described by McCarthy[1] as follows: "In early lesions the whole epithelium shows different degrees of intra and intercellular edema. Later, the squamous cells appear swollen, the interepithelial lymph spaces are widened, and finally, small vesicles are produced. Through their confluence vesiculation appears clinically. In the upper layers of the cutis, the blood vessels are dilated and plugged with leucocytes. The lowest layers of the cutis and subcutis appear to be entirely uninvolved."

Von Hebra,[2] in 1866, described a group of skin lesions which had a like pathology. He believed, however, that they were not caused by the same etiological agents and called them "polymorphus erythemas." In this group he placed erythema nodosum, erythema exudativum multiforme, roseola exuda-

From the Willard Parker Hospital.

tivum, and urticaria. He described in erythema exudativum multiforme the typical polymorphous skin rash, constitutional symptoms, etiology, and pathology. He noted among the cases he had seen that there were occasional patients with bullae and mucous membrane involvement.

Although we give credit to von Hebra for first describing this disease, we know through Beaudonnet's monograph,[3] in 1894, that two Frenchmen, Alibert and Bazin, described an erythema multiforme-like skin rash with conjunctivitis and stomatitis in 1822. Wanton-Jones (Rutherford[4]) reported membranous conjunctivitis with a similar skin rash in 1855. Kaposi,[5] 1893, and Duhring,[6] 1896, described the disease admirably. In three reports from 1895 to 1904, Osler[7, 8, 9] added to the syndrome visceral, joint, and purpuric manifestations. Little that is new has been added to the literature since that time in either etiology, or symptomatology, or pathology.

It is worthy of note that in France, in 1917, Fiessinger and Rendu[10] described necrotic, pseudomembranous, excoriating mucous membrane lesions involving the mouth, eyes, genitalia, vagina, and rectum, with and without multiforme erythematous skin lesions, which they called "ectodermoses erosives pluriorificielles." Stevens and Johnson,[11] in this country in 1922, reported a similar syndrome which, at the time, they felt was a new disease. It seems likely that both of these belong in the erythema exudativum multiforme group.

There have been three epidemics of erythema multiforme reported. Rigler reported an epidemic in Turkey in 1852 (Rosenberg[12]). A second epidemic in Turkey of 105 cases, some bullosum in type, was reported by Duhring[6] in 1896. The third occurred in an army camp in Texas during the first World War, reported by Guy in 1918.[13] He described forty-seven cases of erythema multiforme, some of which had bullous and mucous membrane lesions. He also noted visceral and joint lesions and recurrent skin rashes.

Excellent reviews of the entire subject, with bibliography, have recently been written by Keil[14] and Bailey.[15] One thing that has not been stressed is the differentiation of erythema multiforme from the acute contagious diseases.

We cannot give all case reports from the foreign literature.[16-21] In the American literature approximately thirty-six cases of erythema multiforme bullosum have been reported to date.[22-42]

CLINICAL MATERIAL

During the past twelve years at Willard Parker Hospital, from January, 1932, until July, 1944, twenty-eight cases of erythema multiforme bullosum were admitted. There were five fatalities. Sixteen of the cases are included in this report. In all cases here reported, the following characteristic lesions were seen:

1. Multiform erythematous skin lesions
2. Bullous formations on the skin or mucous membranes
3. Presence of constitutional symptoms compatible with an acute infectious disease

We have omitted, of course, all cases of erythema multiforme which had no bullae. We have also omitted those patients with bullous, excoriating, or membranous mouth and other mucous membrane lesions which had no concomitant skin eruption. Since these cases did not meet all these criteria, they were not included in this series although we feel they belong in the same clinical group.

The patients have been evaluated roughly in terms of mild, moderately severe, severe, and grave cases depending upon the severity of the constitutional symptoms, the skin rash and mucous membrane eruption. The terms mild, moderate, and severe have also been used to describe the severity of these specified symptoms.

In general, mild constitutional symptoms included a low grade fever of a few days' duration, accompanied by slight malaise. Mild mucous membrane and skin lesions consisted of a few scattered bullae on the skin and one or two discrete lesions on the buccal mucosa or genitalia. Patients with moderately severe cases had temperatures ranging between 101 and 102° F., lasting about one week, and more obvious signs of malaise, headache, and vomiting. Moderately severe skin and mucous membrane lesions showed more extensive involvement of the surface with more pronounced edema and weeping. Severe cases were those with temperatures ranging from 102 to 104° F., marked prostration, a skin rash with many confluent bullae covering most of the body, and a necrotizing, sloughing stomatitis, conjunctivitis or vaginitis. The grave forms of the disease included those cases with marked prostration, coma, or shock with complete involvement of the skin surface and sloughing of mucosal areas which could be examined directly and possible involvement of all mucosal surfaces as evidenced by emesis and expectoration of thick necrotic slough. A more detailed description of these findings will be given in the general discussion, and a typical case of each one of the four groups is reported in detail. Case numbers referred to are those in Table I.

MILD FORM

CASE 3.—A 10-year-old Porto Rican boy was referred to Willard Parker Hospital on July 10, 1933, as a case of generalized vaccinia.

History.—His family history was essentially negative. He had had mumps previously. On July 1st he was vaccinated successfully with smallpox virus. Nine days later, the day before admission, he became febrile and complained of a headache. A rash appeared on his face and to a less extent on his body and extremities. A similar rash, though milder, had been noted one month previously.

Physical Examination.—The boy appeared poorly nourished, not very ill though somewhat toxic, with a temperature of 100.6° F.; pulse, 96; and respirations, 22. His face was flushed, edematous, with large bullous lesions covering both cheeks and containing a clear yellow fluid. There were many smaller bullae over his forehead. Between these lesions were numerous, almost confluent, pink papules. Over his sternum were approximately six bullae in a "V" shape. Both arms were heavily covered with small and large irregular papules. Over the trunk and lower extremities were scattered small pin-point maculopapules. There were no vesicles, pustules, or crusted lesions. On his left arm was an active smallpox vaccination in the pustular stage, not infected.

Laboratory Findings.—Nose and throat cultures for *Corynebacterium diphtheriae* were negative. Urine was normal.

TABLE I. ERYTHEMA MULTIFORME BULLOSUM; CASES AT WILLARD PARKER HOSPITAL

CASE	AGE	SEX	YEAR	DIAGNOSIS OF SENDING AGENCY	CONSTITUTIONAL SYMPTOMS*	SKIN RASH*	MUCOUS MEMBRANES*	W.B.C.	POSSIBLE ETIOLOGY	DURATION OF ILLNESS	REMARKS
Group A (mild)											
1	3	M	1943	Varicella	1+	2+		9,300		3 wk.	Recovered
2	9	F	1940	Mumps, erythema multiforme	1+	2+				6 wk.	Recurrent erythema multiforme for 6 wk.
3†	10	M	1933	Vaccinia	1+	1+	2+		Smallpox vaccination 10 days before	1 wk.	Similar rash 1 mo. previously
Group B (moderate)											
4	52	M	1943	Observation diphtheria	2+	2+	2+	19,200	Sulfonamide	2 wk.	Recovered
5†	7	F	1943	Scarlet fever	2+	2+	2+	5,000	Sulfonamides	3 wk.	Recovered
6	16	M	1932	Diphtheria	2+	2+	3+			3 wk.	Recovered
7	6	M	1935	Possible erythema multiforme	2+	3+	3+	11,500		3 wk.	Recovered
8	16	M	1943	Diphtheria	2+	2+	2+	11,550	Sulfadiazine	3 wk.	Recovered
Group C (severe)											
9	14	M	1933	Diphtheria Pneumonia	3+	2+	3+	12,000		6 wk.	Recovered
10	27 mo.	F	1935	Vaccinia	2+	3+	3+		Smallpox vaccination 10 days before	?	Transferred on 2nd day no follow-up
11†	4	M	1934	Varicella	3+	3+	1+			4 wk.	Recovered
12	3	M	1935	Rubella	3+	2+	3+			5 wk.	Recovered
Group D (grave)											
13‡	9	F	1942	Meningitis	3+	3+	3+	21,500		6 days	Died
14	6	F	1937	Observation scarlet fever	3+	3+	3+	10,500		5 days	Died
15	13	M	1937	Impetigo	3+	3+	3+	9,000		7 wk.	Recovered
16†	9	F	1939	Varicella	3+	3+	2+	6,100	Fowler's solution	7 days	Necropsy

*Described in text.
†Detailed case report.
‡Fig. 2.

1+ = Mild.
2+ = Moderate.
3+ = Severe.

Course.—The patient became afebrile twelve hours after admission and remained so. In two days the bullae had practically all dried up, leaving thin crusts on the surfaces, and the papular rash was fading. There was no mucous membrane involvement. On his first day he complained of slight itching; this was relieved somewhat with calamine lotion. Otherwise no therapy was given. On the fifth hospital day he was discharged with a few remaining thin crusts on his body and extremities. The discharge diagnosis was erythema multiforme bullosum following vaccination.

The etiological implication is questionable in view of the history of a similar rash one month previously.

MODERATELY SEVERE FORM

CASE 5.—A 7-year-old white American girl was sent to Willard Parker Hospital by a physician with a diagnosis of scarlet fever. She was admitted Oct. 13, 1943.

History.—This girl was one of three children with a normal family and past history. She had measles previously. Three weeks before admission she became ill with a bilateral

otitis media for which a myringotomy was performed. She then received for ten days a total of 44 Gm. of sulfadiazine. The day after this drug was discontinued a skin rash appeared, accompanied by fever and sore throat, diagnosed by one physician as measles and by another as scarlet fever. She was treated then with a liquid form of sulfathiazole every three hours for five days. Her eyes became edematous and watery, and her lips became sore during this period. She had also received during this illness potassium citrate, aspirin, some cough syrup and "sulfadex" nose drops. Her condition became worse and she was transferred to the hospital.

Physical Examination.—The patient was a thin, drowsy, toxic, dehydrated girl appearing very ill, with a temperature of 101.4° F.; pulse, 124; and respirations, 48. Her skin was highly pigmented, dark red, with hemorrhagic blotches over her face, neck, trunk and less on her extremities. Large bullae were scattered profusely over her trunk. There was a generalized hyperesthesia of the skin. Both conjunctivae were hyperemic with a watery discharge. The eardrums were hazy. Her lips, buccal mucous membranes, gums, palate, and pharynx were red, ulcerated, desquamating and quite tender. The tongue was not involved. The remainder of the examination revealed nothing unusual.

Laboratory Findings.—The admission blood culture and vaginal smears showed no microorganisms. There was no demonstrable sulfadiazine or sulfathiazole in the circulating blood. The urine contained a moderate number of white blood cells on admission but rapidly cleared. Hemoglobin was 53 per cent, red blood cells 3,000,000 per cubic millimeter, white blood cells 5,000 per cubic millimeter with a differential count of polymorphonuclear leucocytes 21 per cent, lymphocytes 70 per cent, and monocytes 9 per cent.

Course.—A continuous infusion of glucose and saline was immediately started, to which was added whole blood, and vitamins K and B. Her temperature rose to 104° F. shortly after admission. She received boric acid eye compresses and sodium perborate mouth washes followed by painting the mucous membranes with aqueous gentian violet. Boric acid ointment was applied to the skin as necessary.

After two days in the hospital the temperature fell to 100° F. She was improved, more alert, and taking some fluids by mouth. Most of the bullae had ruptured leaving bright red, moist, sensitive surfaces, not infected. Her eyes were puffy and red with a moderate conjunctivitis and purulent discharge. Most of the mucous membranes of the mouth were now covered with a gray-white membrane, especially under the tongue. The soft tissues beneath the tongue were quite edematous. On this day excoriations appeared around the vulva and anus.

She improved steadily, becoming afebrile by lysis on the fourth hospital day. By then she was alert, sitting up, cheerful, eating, and her skin was healing rapidly, although the mucous membrane lesions were less amenable to treatment. One week after admission the entire skin surface desquamated but there was still a moderate conjunctivitis. On the sixteenth hospital day she was discharged, much improved but had residual desquamation of both soles. All skin and mucous membrane lesions had healed. The discharge diagnosis was a "toxic eruption due to sulfathiazole."

Although this skin and mucous membrane eruption was attributed to a sulfonamide sensitivity, the patient had received other drugs and had had a bacterial infection, the otitis media. These cannot be eliminated as etiological factors.

SEVERE FORM

CASE 11.—This patient was a 4-year-old Porto Rican male referred from another hospital with a diagnosis of chicken pox on April 9, 1934.

History.—Sometime in the past, the child supposedly had varicella. The family history was uninformative. The day before admission he had malaise, fever, and a skin rash.

Physical Examination.—When first seen, the child was mildly ill with a temperature of 100° F.; pulse, 100; and respirations, 24. There were large, clustered, watery, spherical

bullae on both sides of the neck, back of scalp, face, chest, and abdomen. Some had a papular base. On the hard palate were three small vesicles. The tonsils were hypertrophied and injected.

Laboratory Data.—The urine was normal on repeated examination. Nose and throat cultures for *C. diphtheriae* were negative.

Course.—After admission the boy became much worse; the temperature spiked to 102° F., and by the third hospital day he was quite toxic and had huge bullae over all his body. There were great blebs over the ankles, dorsum of both wrists, and feet. Some bullae appeared on normal skin, some were surrounded by erythema, some had ruptured leaving a red, raw surface and others were purulent. Over his back were many confluent macules. The mucous membranes of his mouth were involved, but the lesions were not described.

It was decided to treat him as though he were extensively burned and the current burn therapy of that day was begun. All of the bullae were ruptured, debrided, and a 5 per cent tannic acid spray was used repeatedly. He was placed on sterile sheets, under a light cradle without clothes. Sedation used was chloral hydrate and phenobarbital.

Much of the skin subsequently became infected and for two weeks he ran a septic course with temperature spiking to 104° F. daily. After ten days there was some evidence of healing of the skin but he was still quite ill. At the end of two weeks he was definitely improving but new bullae were still forming occasionally. During the height of his illness he had diarrhea, lasting three days, treated successfully with paregoric and bismuth subcarbonate. During most of his hospital stay he was extremely constipated. On the seventeenth hospital day he was afebrile and the skin lesions were crusting and healing. He was discharged twenty-five days after the onset of his illness, well except for a few dried crusts. The discharge diagnosis was erythema multiforme bullosum and diarrhea.

There is no obvious evidence of an etiological factor in this case. One of the most severe complications of this disease, namely pyodermia, is presented.

GRAVE FORM

CASE 16.—A 9-year-old Porto Rican girl was admitted to the hospital on Oct. 18, 1939, because of possible chicken pox.

History.—Previous illnesses included varicella in 1935 and pertussis in 1936. She had had anemia for which she was being treated with Fowler's solution. Four days before admission, she developed a headache, sore throat, earache, nausea, and vomiting. That night she was restless and talked in her sleep. She later became very drowsy and had a purulent discharge from her eyes. On October 16, red blisters appeared and by night they had spread over all the body.

Physical Examination.—The child was semicomatose on admission. There was a maculopapular generalized confluent eruption on a purplish base. Numerous bullae were present on the face, ears, abdomen, and extremities. From between her swollen, closed eyelids oozed thick pus. The mucous membranes of the mouth and tonsils were covered with thick pustular plaques. Moderate cervical adenopathy was noted. The lungs were clear. The heart was of normal size; sounds were of good quality; no murmurs were heard. The child complained of pain on movement of the lower extremities.

Course.—She was given parenteral glucose in saline and aspirin on the day of admission. The following day her skin became denuded in large patches. Local application of tannic acid spray followed by silver nitrate was used and a blood transfusion was given. Her temperature remained about 106° F., and respirations became very rapid, necessitating oxygen. She expired the second night after admission.

Laboratory Findings.—White blood cells were 6,100 per cubic millimeter; red blood cells, 1,900,000 per cubic millimeter with 40 per cent hemoglobin. Nonprotein nitrogen and creatinine were normal. Blood culture showed no growth of any organisms after seven days' incubation. Cultures of both eyes showed rare ***Staphylococcus albus;*** throat cultures showed ***Streptococcus hemolyticus.***

The clinical diagnosis was erythema multiforme bullosum, possibly caused by Fowler's solution.

Necropsy Findings.—(Necropsy performed by Dr. M. Freedman.) The skin of the entire body was covered with numerous vesicles, blebs, and bullae. Light purplish spots of various sizes were seen. The upper one-half of the face was desquamated and reddish bronze in color. There was a right conjunctival hemorrhage and swelling of the conjunctival sacs.

The heart appeared normal. The myocardium was firm. The pleural cavities were dry and no adhesions were noted. The lungs were heavy and atelectasis was noted to a fairly marked degree in all lobes. Areas suggestive of early pneumonia were seen throughout the upper and middle lobes. Both lower lobes showed much congestion. The bronchi, trachea, and larynx showed congestion.

The stomach was moderately distended and contained a little brownish residue. The mucosa was congested but no ulcerations were noted. The intestines and appendix were normal.

The thymus weighed 11 grams.

The liver weighed 810 grams and on section the cut surface bulged markedly. Numerous areas of yellow infiltration were present.

The spleen weighed 130 grams and was bilobed. On section, the entire organ was deep purple in color. The follicles were not prominent. The pulp scraped abundantly.

Each adrenal weighed 7.0 grams.

The kidneys weighed 80 and 77 grams. The cut edge bulged slightly. A little cloudy fluid exuded on pressure from one of the renal calyces.

The brain was congested.

Microscopic Examination.—

Heart: The myocardium showed a marked fragmentation despite a well-preserved striation. A small collection of lymphocytes was present in one area of the epicardium, beneath the mesothelial layer.

Lungs: Microscopically, moderately severe atelectasis was seen throughout both lungs. Areas of marked pulmonary edema with escape of blood into the alveolar lumen and collections of polynuclears in some alveoli were noted. The bronchial walls and the alveolar and pleural capillaries were congested. A collection of lymphocytes was noted around the bronchi in one area and one bronchus was surrounded with a heavy ring of eosinophiles.

Lymph Nodes: There was engorgement of veins and capillaries with blood invading the sinuses. Only occasional lymphoid follicles could be identified.

Thymus: Marked depletion of the lymphoid elements, degeneration of Hassall's bodies, and widening of the septa from edema, was evident.

Pharynx: The mucosa was devoid of epithelium. The stroma was congested, edematous, and showed a moderately diffuse infiltration with lymphocytes and plasma cells.

Liver: The parenchymal cells were opaque; some nuclei were hydropic. Fatty vacuoles were present in some cells. In the periportal areas was a slight mononuclear infiltration.

Spleen: The pulp was diffusely hemorrhagic and congested. The lymphoid tissue of the malpighian bodies was largely depleted and inactive. Hyalinization of the media of some arterioles was present.

Adrenals: Both adrenals were congested. One showed lymphocytic collections around the medullary veins.

Kidneys: The tubular epithelium showed marked albuminous degeneration. Many glomeruli were rather anemic and cellular and filled out the Bowman's capsules.

Stomach: The surface of the mucosa showed a post-mortem autolysis. Dilated veins were present at the base of the mucosa.

Brain: All veins were congested. Occasional petechiae were seen in the adjoining white substance.

Skin: (Fig. 1) In some cases, the epithelium was lifted bodily from the subjacent connective tissue structures, forming small blebs filled with coagulated material or loose flaps leaving the subjacent tissues exposed. Occasionally a slight rarefaction was seen within the thickened and swollen epithelial layer, and rare polynuclears and lymphocytes were found in these small blebs. The subjacent connective tissue contained dilated capillaries, and showed slight edema but did not show any inflammatory cellular infiltration. The connective tissue of the deeper layers showed moderate edema.

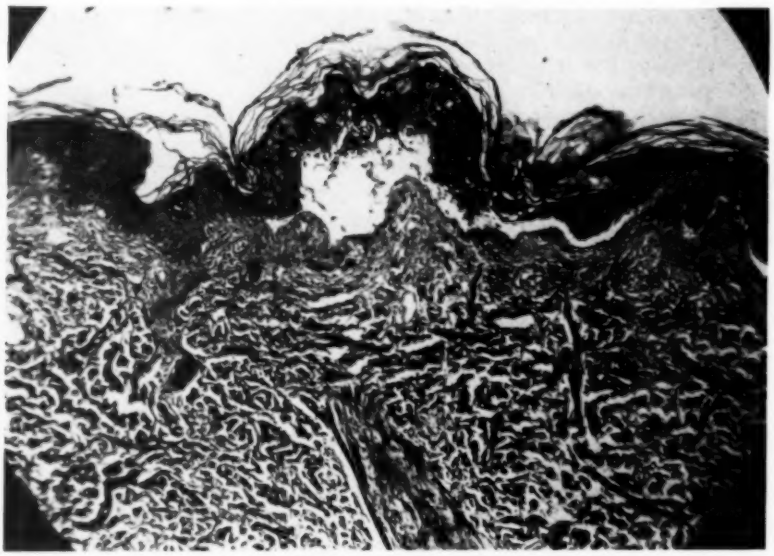

Fig. 1. (Case 16).—A section of skin showing a small bleb separating the epithelial layers from the subjacent tissues.

The clinical picture and necropsy findings of this patient were typical of those who did not survive.

DISCUSSION

General Considerations.—During the past twelve and one-half years at Willard Parker Hospital, 71,901 patients have been admitted, most of whom have had the usual contagious diseases as measles, chicken pox, mumps, scarlet fever, pertussis, meningitis, and tuberculosis. Out of this large number only twenty-eight cases of erythema multiforme bullosum were found, of which sixteen are presented here. In this group, there were three deaths, a mortality rate of 19 per cent.

Although most of the patients are admitted during the winter season with the lowest census in the fall, in this series no such seasonal variation could be found. Over one-half of the cases have occurred in children under the age of 10 years. This predominately young age distribution is concomitant with the age group normally seen in a contagious disease hospital. Ten of the sixteen cases were in males.

This disease is said to be more prevalent in Italy, Turkey, and the Balkans but rare in Western Europe and America (Rosenberg[12]). We thought, therefore, it would be of interest to ascertain the birth places of the parents of our patients. Either the father, mother, or both were born in the following countries:

United States	6	Germany	1
Porto Rico	3	Poland	1
Italy	3	Scotland	1
Russia	2		

Etiology.—In six of the cases etiological factors were suggestive. These included drugs, viruses, and bacteria. In ten of the cases there was no remote suggestion of a causative factor.

Three patients with possible sulfonamide etiology were seen in 1943. The first (Case 4) received a sulfonamide one week before admission for treatment of a sore throat. After three days of drug therapy a typical erythema multiforme bullosum skin rash with involvement of the mucous membranes, penis, and scrotum appeared. The etiological factors in the second patient (Case 5) were similar (see case report). The third patient (Case 8) had an infected tooth and was treated with sulfadiazine and gentian violet. On the same day therapy was begun, the rash appeared. He developed the typical skin and mucous membrane rashes and recovered in three weeks. Fowler's solution was the only other drug which appeared to be a possible causative factor in this series of patients (Case 16).

A virus was suggested as an etiological factor in only two cases which followed closely smallpox vaccination. In Case 3, reported in detail, the patient developed a rash ten days after vaccination, but there was a history of a similar rash previously. The other patient (Case 7), in whom the rash also occurred ten days after successful vaccination, had typical erythema multiforme bullosum lesions.

Keil[14] discusses the role of bacteria in this disease in some detail. From our group of cases, two patients developed rashes one day after the onset of an upper respiratory infection. Five patients had recent sore throats, one of whom also had an otitis media. One patient had an infected tooth just prior to the appearance of the rash. The laboratory findings given later in the paper demonstrate the large variety of associated bacteria found in the lesions.

Some authors believe that erythema multiforme bullosum is an allergic reaction to bacteria present, and not to actual invasion of the microorganisms. No special studies were done in this hospital in connection with these cases. Because of the great variety of possible causative agents, no conclusion could be drawn for a single etiological factor.

Constitutional Symptoms.—The most common complaints were fever, sore throat, headache, vomiting, malaise, and anorexia. Less than one-third had upper respiratory infections, coughs, and nasal obstructions. The severely ill patients had chills, sweating, delirium, convulsions, and coma. Those with oral involvement complained of pain in the mouth, excessive salivation, drooling, and

difficulty in swallowing. Involved eyes often smarted and burned. A few patients complained of itching and burning of the skin, though this was not common and is not a general feature of the disease.

The temperatures in general ranged from 101 to 103° F., lasting most often from one to two weeks. One patient developed the disease in the hospital while convalescing from a fractured leg and skull, and his illness was completely afebrile. Four patients had fever for less than one week, six from one to two weeks, one from two to three weeks, and one over three weeks. The three patients who expired were ill from five to seven days and ran temperatures of 104.8 to 107° F.

Rash.—The skin rashes encountered were principally pink to dark red macular and maculopapular with fourteen of the sixteen patients presenting vesicles and large bullae. About one-half of the patients had a generalized erythema followed later by desquamation. To a lesser extent there were pustules, iris, and crusted lesions. Four patients had purpuric manifestations. Almost all of the patients were left with some degree of pigmentation. It was difficult to get an accurate description of the regional distribution of the lesions. In several of the mild cases the observers recorded the lesions as distributed symmetrically over the trunk and extensor surfaces of the extremities, with fewer lesions on the face and neck, and rarely on the scalp. In the moderate and severe cases the rash was virtually over all the body including the palms and soles (Fig. 2).

The early mucous membrane lesions appeared as vesicles and bullae on erythematous and edematous bases. These quickly spread, ruptured, and appeared as grayish white patches, easily removed, leaving red raw surfaces. More advanced lesions appeared as ulcers and pseudomembranes. Often there were petechiae, ecchymoses, and bleeding surfaces. These mucous membrane lesions were usually more tender and irritating than the skin lesions and, on the whole, healed less rapidly. They were primarily on the lips, buccal mucosa, palate, pharynx, and tonsils. Seven of the patients had a purulent conjunctivitis and three, a catarrhal conjunctivitis. The other mucous membranes involved with incidence of each is as follows:

Nose	3	Ears	1
Penis	3	Rectum	1
Vulva	3	Vagina	1
Scrotum	1		

The skin and mucous membrane lesions lasted on an average of from two to three weeks. Of the sixteen patients, no rashes healed in less than one week, eight lasted from one to four weeks, and four lasted from four to seven weeks. Three patients died within one week, and the other one was transferred to another hospital (Case 10).

Laboratory Findings.—As far as we can tell, none of the laboratory data obtained was helpful in making the diagnosis. Cultures of bullous fluid from six patients revealed no organisms in four, diphtheroids and *Bacillus pyocyaneus*

Fig. 2 (Case 13).—This child had been sick for six days and rash present for two days. Most of the bullae had ruptured, leaving raw surfaces, but some can still be seen on the lower lip, chest, and left wrist. The multiform erythematous lesions are well shown.

in one, and hemolytic streptococcus in the other. *Staphylococcus aureus* or *Streptococcus viridans* was recovered in three eye cultures, and hemolytic streptococcus in one. Nose, throat, and (or) mouth cultures were taken on fourteen patients, most of them containing *Staph. aureus* and *Staph. albus, Str. viridans,* and three contained hemolytic streptococcus. Of two mouth smears, one was positive for Vincent's organisms. Two of three throat smears were also positive for Vincent's organisms. This latter finding is interesting in light of work done by other authors[25-27, 36, 40, 43] who feel that the Vincent's infection is an important etiological factor of this disease. No virus studies were done on any of the specimens obtained. Seven patients had blood cultures made, none of which showed growth of any microorganism.

There were seven Wassermann examinations, one of which was positive in a known syphilitic, and the others were negative. For the initial leucocyte counts refer to Table I. Three of the six patients with counts above 10,000 had pneumonia, but the remaining had no bacterial explanation for their leucocytosis. In the white counts ranging from 5,000 to 10,000, polymorphonuclear leucocyte percentages were 60 to 80. Large mononuclears were from 0 to 10 per cent and eosinophiles from 0 to 3 per cent. On admission eight of the patients had albumin, white blood cells, and red blood cells in the urine. Fewer had hyaline and granular casts. Of those patients, all of the urine examinations were negative within the first one to two weeks of disease.

Pathology.—Histologic examination of the skin and body was made in one fatal case. The microscopic appearance of the skin was essentially identical with that described by Gans,[44] McCarthy,[1] and Edgar and Syverton.[28] While the mucosa of the pharynx was devoid of epithelium, and clinically, necrotic plaques were noted over the buccal surfaces, no specific pathologic changes of any of the mucosal surfaces were noted which would correspond to the histologic appearance of the skin in this disease. The pathologic changes seen in the other organs and tissues were all of a toxic nature.

Treatment.—From 1932 to 1937, none of the cases were severe and no general or specific therapy was used. In 1937, sulfanilamide was first used, followed later by sulfathiazole and sulfadiazine. Penicillin has been used only on one case, which is not reported here. Supportive measures have included parenteral fluids, plasma, blood transfusions, serum, vitamins, and adrenal cortex extract.

From 1934 to 1940, several patients were treated locally with silver nitrate or tannic acid sprays. The results were not striking and since 1940 local treatment has included calamine lotion, sodium bicarbonate, boric acid, olive oil, cod-liver oil, and gentian violet. The latest addition has been sulfathiazole ointment. Bland ointments and irrigations have been used in treating the eye lesions. Mouth care consisted, in general, of sodium perborate, boric acid, sodium bicarbonate, gentian violet, hydrogen peroxide, and potassium permanganate.

Complications.—Pneumonia was the most common complication, occurring in three patients. Single cases of pyodermia, diarrhea, sinusitis, and uremia occurred.

Differential Diagnosis.—One of the most striking facts that has come out of this study is the apparent difficulty in diagnosis. Only one case out of the sixteen was sent to the Willard Parker Hospital with the correct diagnosis. In one other case a tentative diagnosis of erythema multiforme was made. Diphtheria, chicken pox, and vaccinia are most likely to be confused with this disease. For the variety of incorrect diagnoses see Table I.

Four of the cases were referred as diphtheria. These two diseases have little in common except a necrotic and membranous throat lesion which clinically and bacteriologically can usually be differentiated. A soft, friable membrane may be found in both diseases in the nose, conjunctivae, or on the genitalia, and be difficult to differentiate without the help of the entire clinical picture and laboratory data. In diphtheria, we see a grayish white, thick, tough membrane on the tonsil, pharynx, or palate, difficult to remove, leaving a bleeding, raw surface underneath. In erythema multiforme bullosum, there is a soft, friable, easily removed pseudomembrane, spread not only on the pharynx, tonsils, and palate, but all over the lips, buccal mucous membranes and floor of the mouth. Three additional features are helpful in making the correct diagnosis. First, diphtheria patients usually have little fever and may be quite toxic or in profound shock. Erythema multiforme patients, on the other hand, usually have an acute febrile illness. Secondly, diphtheria patients have no skin rash except for occasional petechiae seen in very toxic infections. Thirdly, in diphtheria the specific microorganism can usually be found.

Three of the cases were referred as chicken pox. This confusion seems justified as that disease is an acute febrile illness with a polymorphous skin rash in which blebs predominate. There are a few points that should make the diagnosis clear immediately or at least in a day or two. First, varicella skin lesions are progressively macular, papular, vesicular, pustular, and crusted, with varying stages of the lesions present at the same time, whereas, in erythema multiforme, the lesions do not progress orderly. Second, bullous lesions in varicella occur uncommonly. Third, in varicella there are usually from one to four small lesions in the mouth but rarely the necrotic, ulcerating, pseudomembranous lesions of erythema multiforme bullosum. In varicella, the skin rash is usualy quite pruritic, as opposed to erythema multiforme, and the constitutional symptoms are on the whole much less severe. A history of exposure to chicken pox in susceptible patients is usually helpful.

Two cases were referred as generalized vaccinia. In this condition, which usually appears from ten to fourteen days after smallpox vaccination, only one type of skin lesion is present. The skin lesion develops through the macular, papular, vesicular, pustular, and tough crusted stages as the original vaccination. These lesions are likely to be all in the same stage and distributed all over the body except the mucous membranes. There are no polymorphous erythematous lesions, or bullae present as found in erythema multiforme bullosum.

As in vaccinia, smallpox can also be confused with erythema multiforme bullosum. The correct diagnosis should be made on the basis of the history of exposure to variola and the character of the skin rash.

Erythema multiforme bullosum has been confused with scarlet fever, measles, meningitis, or impetigo, although the skin rash alone should suggest the diagnosis. Yet it will be seen from Table I that five of the sixteen cases were originally mistaken for these diseases. Undoubtedly familiarity with the syndrome of erythema multiforme bullosum would lead to more correct diagnoses.

No attempt has been made to discuss the differential diagnosis of this disease with the noncontagious dermatological diseases as pemphigus, exfoliative dermatitis, or epidermolysis bullosa. This subject has been treated at great length elsewhere. We wish, primarily, to stress the importance of differential diagnosis with the acute contagious diseases.

SUMMARY

Erythema multiforme bullosum is an unusual form of erythema exudativum multiforme (Hebra) which has been recognized for over a hundred years. It is an acute inflammatory disease of the skin with mild to severe constitutional symptoms, occasionally causing death. There is no known etiology but allergic reactions to food, drugs, or bacteria are commonly considered as the cause.

We have presented sixteen cases seen at Willard Parker Hospital during the past twelve and one-half years. These cases were presented in order to review the subject briefly, and to stress its importance in differential diagnosis of acute contagious diseases.

The photograph (Fig. 2) was taken and presented to us by Dr. Lewis Koplik, instructor and attending physician at Willard Parker Hospital. Dr. Vera Dolgopol, pathologist of Willard Parker Hospital has been very kind in helping us prepare the necropsy and pathologic data. We wish to thank especially Dr. Jerome Kohn for his assistance in preparing the material for publication. We thank Dr. Maurice J. Costello, the consulting dermatologist at Willard Parker Hospital for his assistance.

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PNEUMONIA DUE TO STREPTOCOCCUS VIRIDANS

Review of Literature and Case Report of an Infant

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ALPHA streptococcus, as an important etiological agent in pneumonia, has been the subject of some debate. In fact, Reiman[1] stated that this organism is definitely associated with only one disease, subacute bacterial endocarditis. There are only scattered reports of cases of pneumonia attributed to this organism and some leave doubt as to their true etiology. In our brief review of the literature, no reports of the disease in younger children were found.

Diagnosis of alpha streptococcus pneumonia is not simple; and finding of the organism in the sputum, even in pure culture, is insufficient proof of the diagnosis although it should stimulate search for the organism in blood, pleural fluid, and lung juice, particularly in atypical pneumonias. In the opinion of Carey,[2] the diagnosis of *Streptococcus viridans* pneumonia is difficult because of the occurrence of this organism in the nasopharynx and sputum normally. In a study of the nasopharyngeal flora in infants at the Infants' and Children's Hospital in Boston, it was determined that the basic nasopharyngeal flora was made up of organisms commonly regarded as nonpathogens of which *Str. viridans* was the organism most commonly found.[3]

Kneeland and Smetana[4] reported a series of cases of atypical pneumonia and stated that streptococcus viridans was the predominant organism in most of their cases and believed it probably without significance since in their laboratory it was the usual finding in a great number of normal patients. Longcope,[5] too, did not attach any significance to alpha streptococci in throat cultures in a series of cases of bronchopneumonia of unknown origin and reported them as without etiological meaning.

However, when sputums, which are positive for *Str. viridans* are found, inoculation of mice followed by plating of the peritoneal exudate has been advised,[4] and we coincide in this opinion. Bile solubility tests should be performed routinely to differentiate pneumococcus from streptococcus colonies. Sputum typing by capsular swelling will fail to disclose the *Str. viridans*, and sputum culture on blood plates is essential.

Clinically, the diagnosis of pneumonia due to *Str. viridans* should be suspected in any atypical pneumonia. Intense pleural pain was a common symptom as noted by Solomon and Kalkenstein[6] and was present in two of three patients in another series. Failure of response to chemotherapy is the sine qua non and true of all cases reported. All the cases reviewed[6, 7, 8] (Table I) were of long duration with hospital stays ranging from fifteen to sixty days in those cases recovering, and those patients who did recover tended to do so by lysis rather than by crisis. The majority of patients reported had lobar consolidation with the tendency of the process being to spread and involve more than one lobe. In the cases in which post-mortem examinations were done, intense,

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TABLE I. REVIEW OF REPORTED CASES OF ALPHA STREPTOCOCCUS PNEUMONIA

	AGE	SEX	TYPE*	CULTURES			DISEASE DURATION (DAYS)	OUTCOME
				SPUTUM	BLOOD	PLEURAL FLUID		
	27	M	L	+	-	-	36	R
	45	M	B	+	-	-	58	R
1941	13	M	L	+	-	-	25	R
Senercha	19	M	L	+	-	-	1	D
and	54	F	L	+	-	-	22	R
Livengood	51	M	L	+	-	-	23	R
	18	F	L	+	-	+	49	D
	26	M	L	+	-	-	15	R
	82	M	L	+	+	+	8	D
1943	20	F	L	+	0	+	26	D
Solomon	59	M	L	+	0	+	26	D
and	52	M	L	+	+	+	60	R
Kalkenstein	59	M	L	PN 3, 12, 32†	+	0	50	D
	20	M	B	+ PN 6†	+ P.M.‡	+ Lung exudate P.M.§	5	D
1943	46	M	B	+	+		15	D
Thomas	Nurse†	F	B	+	0	-	45	R

*L, lobar pneumonia; B, bronchopneumonia.
†PN 3, 12, 32, 6 = Pneumococcus types 3, 12, 32, 6
‡+P. M. = Positive blood culture post mortem
§+Lung Exudate P.M. = Positive culture post mortem
R = recovered
D = died

purulent bronchiolitis was the chief finding with lobar involvement. Empyema as a complication is not infrequent, and none of the thoracenteses done yielded purulent material, but rather, thin, yellow fluid with a predominance of polymorphonuclear cells. In none of the cases reviewed was a cardiac lesion found either clinically or at autopsy.

We should like to present what we believe to be a case of *Str. viridans* pneumonia in a 7-month-old female infant. In all respects the patient's clinical course paralleled previous case reports except that the infant appeared to tolerate the infection better than adults with the disease. Also, penicillin was used for the first time, we believe, in the treatment of this disease with questionably good results.

CASE REPORT

This 7-month-old female infant (C. M.) entered the Pediatric service of the North Carolina Baptist Hospital on Nov. 15, 1944, because of cough, fever, and vomiting. Birth history and family history were not remarkable. The child had nursed at the breast up until the time of admission and had been given no accessory vitamins. She had had no immunizations, previous illness, nor known exposure to infectious disease.

Present illness was dated by the mother to about one month prior to admission at which time the child developed a severe, hacking cough which persisted and was worse at night.

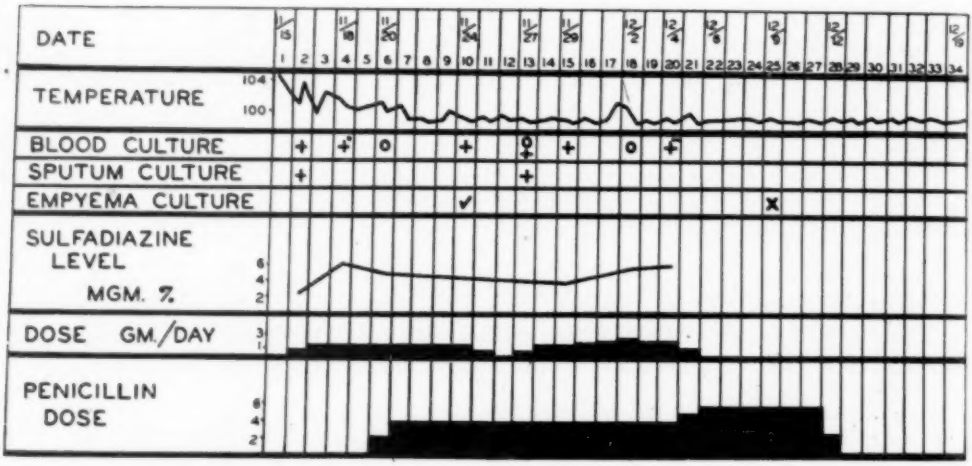
Ten days before admission she had high fever, and her mother thought her abdomen was sore. One week before admission a local physician saw the child whose temperature was 102° F., and he made a diagnosis of "grippe." Improvement did not occur, and questionable history of sulfonamide therapy was obtained. On the day before entering the hospital the child nursed poorly and vomited most of her feedings, and when she was seen that evening, her temperature was 103° F. Diagnosis of bronchopneumonia was made. Because the child did not improve, was having severe coughing spells with cyanosis, and was becoming unresponsive, she was referred to the hospital for treatment. She had had only a mild watery diarrhea in the week prior to admission.

Physical examination revealed: Temperature 103° F.; pulse, 120; respiration, 24; weight, 18 pounds, 10 ounces. The patient was a well-developed, well-nourished female infant, acutely ill, whose skin was a ghostly gray. She was stuporous, and eyes were rolled upward. She was not markedly dehydrated although the anterior fontanel was depressed. There was no meningismus. There was a moderate pharyngitis.

Respiratory lag was present on the left side of the chest. Anteriorly, there was dullness of the left upper and upper half of left lower lung fields. Breath sounds were diminished in intensity over areas of dullness, and there were moist râles in all lung fields.

Abdomen was distended but soft. Liver was barely palpable, and no other masses were felt. Genitalia and extremities were not remarkable, and there was no abnormal lymphadenopathy. Rectal examination revealed a green watery stool. Impression on admission was of bronchopneumonia of the left lung and parenteral diarrhea.

CHART I



Key for Chart:

+ = Positive culture (alpha streptococcus)

+* = Organisms inhibited in vitro by penicillin

+** = Organisms uninhibited by penicillin in concentration of 1 or 10 u./c.c. and uninhibited by sulfanilamide, sulfathiazole, sulfadiazine, sulfamerazine, and sulfapyrazine in concentrations of 12½ mgm.%

♀ = *Staph. aureus* (nonhemolytic) assumed contaminant

√ = 2 to 3 c.c. thin, yellow fluid; gram stain revealed organisms similar to organisms recovered from blood culture; cultures sterile.

× = Lung juice; organisms again stained; all cultures including chick embryo cultures sterile.

X-ray therapy given on twenty-eighth and thirty-fifth days.

Accessory clinical findings revealed: Urine normal without acetone. Blood: hemoglobin, 7.4 Gm. (Sahli); red blood cells, 3.0 million; white blood cells, 16,800, with 71 per cent polymorphonuclears, 18 of which were nonsegmented. Stool was green-watery and polymorphonuclear cells in clumps were present. Culture of stools yielded no pathogens. The carbon dioxide combining power was 40 volumes per cent on admission. Serology was negative. Tuberculin tests were not done. Acid-fast stains of sputum were negative.

The child was given parenteral fluids and was started on sulfadiazine (grains, 1 per pound per day) soon after admission, and on the following day she appeared much more alert. Physical examination at that time showed signs of consolidation over the entire left chest. Sputum culture on admission yielded alpha streptococcus plus other organisms. Blood culture was positive for *Str. viridans*. The child did not appear to be dehydrated after her second hospital day and took her formula well. Her condition did not seem to be as critical as her laboratory procedures indicated.

Blood culture on the fourth hospital day was again positive for *Str. viridans*, and although her temperature had gradually decreased from 104 to 100° F., penicillin therapy was begun. Organisms from the blood culture were determined to be inhibited in vitro by penicillin. On the sixth hospital day, a sterile blood culture was obtained prior to the administration of penicillin, but on the tenth hospital day blood culture was again positive for *Str. viridans*. Thoracentesis on the tenth hospital day also yielded from 2 to 3 c.c. of a thin yellow fluid which contained 45,000 white blood cells per cubic millimeter, predominately polymorphonuclear, and which on gram stain showed small gram-positive diplococci resembling the organisms seen on blood culture. Culture of this pleural fluid, however, was sterile.

Sputum culture on the thirteenth day revealed an almost pure culture of alpha streptococcus, and on the fifteenth day another positive blood culture was obtained. On the eighteenth day the child's blood culture was sterile once again. Throughout this period the child had been running an almost normal temperature and clinically was much improved.

Then again, on the twentieth day, another positive blood culture was obtained, and this time the organisms were found to be uninhibited by penicillin in a concentration of either 1 or 10 units per cubic centimeter and were also uninhibited by sulfanilamide, sulfathiazole, sulfadiazine, sulfamerazine, and sulfapyrazine in a concentration of 12½ mg. per cent. Sulfonamides were discontinued. On the twenty-fifth hospital day blood culture was again sterile and remained so throughout the remainder of her hospital stay.

Lung juice was aspirated on the twenty-fifth day, and a gram stain again revealed organisms resembling the original *Str. viridans*. However, routine cultures, plus cultures on chick egg embryo, were all sterile. On the child's twenty-eighth day penicillin therapy was discontinued.

She was given x-ray spray treatment on her twenty-eighth and thirty-fifth days in an effort to stimulate bone marrow to produce more polymorphonuclear cells without appreciable results. There was a negative skin reaction to a vaccine of autogenous *Str. viridans*. No vaccine therapy was given.

The child was finally discharged on the thirty-sixth hospital day in good condition. Physical findings in the chest had cleared up only very gradually, and x-ray examination of the chest, which on admission had shown a nonspecific diffuse pneumonitis and left pleural effusion, showed that the pleura was slightly thickened over the lateral left chest wall and that the pneumonitis had improved.

SUMMARY

A review of the literature reveals few cases of pneumonia, proved or suspected, to be due to *Str. viridans*.

Clinically, pneumonia due to an alpha streptococcus resembles closely so-called primary or atypical pneumonia and is to be suspected in all cases, especially if the organism predominates on sputum culture.

Sulfonamide therapy has no effect on the course of the disease and penicillin in this case was of questionable effect.

A case of alpha streptococcus pneumonia in a 7-month-old female is presented. This is, we believe, the youngest patient reported with this disease.

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CONGENITAL MEGACOLON

Treatment With Mecholyl Bromide

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Milwaukee, Wis.

EVER since Ammon (1842) and Favalli (1846)[1] described congenital dilatation and hypertrophy of the colon, the etiology of the anomaly has remained a mystery. Many cases of moderate dilatation remain undiagnosed for years in spite of the persistent constipation which usually becomes obstipation. Surgical treatment of this condition has been for the most part unsatisfactory and carries a high mortality. The later surgical treatment by lumbar and presacral sympathectomy has also been hazardous and unsatisfactory.[2]

In 1940, Law reviewed the literature on medical and surgical treatment of megacolon and presented fifteen cases treated with acetyl-beta-methylcholine chloride and bromide.[3] Law described the dysfunction of the autonomic nerve supply to the affected colon and reviewed the pharmacologic action of the cholinergic drugs. He presented a method of medical management which was highly successful in the treatment of his patients and which has been the basis of the treatment in the cases described in this paper.[4]

The regimen depends on the action of acetyl-beta-methylcholine bromide which increases the tonicity of the dilated colon and relaxes the spasm of the anus. The patients are all hospitalized and the colon is first cleansed. The drug is then given orally in small initial doses, 0.05 Gm. before or after breakfast, and the dosage is increased as necessary to 0.2 Gm. once or, if necessary, twice a day to produce results. An enema is given two hours after the drug is administered, and mineral oil is given every night to keep the stool soft. After a definite evacuation time is established the enemas may be discontinued and subsequently used only when necessary. When a satisfactory diet has been established the mineral oil may be gradually reduced in amount and then discontinued. The Mecholyl bromide may be gradually reduced as satisfactory results continue. I have seen no toxic reactions to the drug although one patient, A. J., received 2.0 Gm. daily for three days in error. I have also seen no unfavorable reactions to the continued dosage of 0.2 Gm. twice daily for sixteen months.

CASE REPORTS

B. R. This 2-year-old girl was first seen April 10, 1937. She had been constipated from birth. The stool was said to be ribbon-shaped. Constipation was not relieved by excessive doses of cathartics, and the bowels could be evacuated only by repeated enemas. Examination revealed a prominent abdomen, distended with large loops of dilated colon. X-ray after barium enema Dec. 20, 1941, showed the large dilated and redundant loops of colon (Fig. 1). This child was treated palliatively until Dec. 24, 1941. At that time mecholyl bromide was started, 0.1 Gm. every morning. Mineral oil was given, 30 c.c. every night. This seemed to produce one to two large stools a day until April, 1942, when fecal masses remained after evacuation. The mecholyl was increased to 0.2 Gm. twice a day, and oil enemas were given as necessary. The stools continued, one or two a day, but they were still large. The abdomen

remained large and distended. The child seemed always to be soiled due to leakage of some fecal material (and mineral oil?). However, the anal sphincter was tight. August, 1943, the mineral oil was replaced with Zymenol,* 30 c.c. every night. The mecholyl was reduced to 0.1 Gm. twice a day. There was little soiling. The child continued to have large stools but at least one daily until August, 1944, when the mecholyl was changed to 0.2 Gm. daily. March, 1945, the stools were still excessively large although there were one or two daily. The dosage of mecholyl bromide was changed to 0.4 Gm. once daily. At time of writing the abdomen is no longer large. There are one or two stools daily. There is no soiling or leakage.

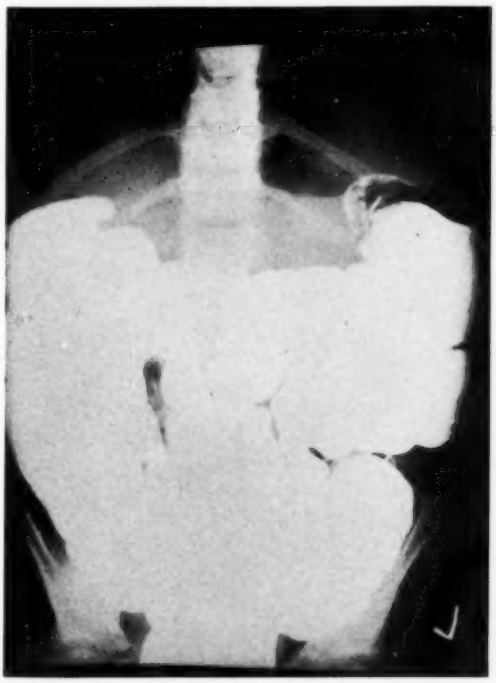

Fig. 1. (Patient B. R.)

T. R., a 6-year-old boy, was first seen July 11, 1941, because of constant soiling of his clothes. He seemed to have no control of his anus, and his underwear and clothes were always soiled with fecal material. Strangely enough, there was no complaint of constipation. Apparently there was never a very large stool. Examination revealed a large nodular mass in the right side of the abdomen which consisted of fecal material. The anus was quite tight. The x-ray after a barium enema showed the enormously dilated colon (Fig. 2). This child was hospitalized for one week and was stabilized on mecholyl bromide, 0.1 Gm. morning and night, mineral oil, 15 c.c. every night, and a normal saline enema two hours after breakfast. The boy had two stools daily, the abdomen was soft, there was no distention and no further soiling. After three weeks the mineral oil was gradually reduced in amount to 4 c.c. per dose. After two months the mecholyl was reduced to 0.1 Gm. once a day. The child continued to have two stools daily and no soiling. Within two months the mecholyl was reduced to 0.1 Gm. every three days, the mineral oil and enemas were discontinued entirely. The mecholyl was discon-

*Zymenol (by volume): processed brewer's yeast (entire aqueous culture) 39 per cent. mineral oil 60 per cent, agar-agar 1 per cent.

tinued four months later. The boy has continued to have one or two stools daily for four years after treatment. The abdomen is normal in size.

A. J. was first seen Aug. 2, 1942. He was a 9½-year-old boy who had never had a normal bowel movement and had never evacuated a stool without an enema since he was born. At 8 months of age the boy had had a lumbar sympathectomy at one of the large clinics, but this had not the slightest effect on the bowel movements. The stools were excessively large in size and could be removed only after large doses of cathartics and one to several enemas. Finally the enemas did not return, and the mother became quite adept in hydraulic engineering to get the solution back. The abdomen was excessively large and distended. The anal sphincter was tight. X-ray after barium enema showed the size of the dilated colon (Fig. 3). The boy was hospitalized for twelve days and was stabilized on mecholyl bromide, 0.2 Gm. twice a day, mineral oil, 15 c.c. twice a day, and a glycerine suppository two hours after breakfast. Within three months after discharge from the hospital the suppository was discontinued. One month later the mecholyl was reduced to 0.2 Gm. once a day. Six months later the mecholyl was discontinued entirely and this boy has had from one to two stools every day since.

Fig. 2. (Patient T. R.)

R. C. was first seen Aug. 11, 1942. He was a 14-month-old infant who had never had a bowel movement except after an enema. He had a large distended abdomen. The loops of the large dilated colon could be plainly seen through the abdominal wall. The anal sphincter was tight. X-ray showed the large dilated colon (Fig. 4). He was hospitalized for eighteen days when he was stabilized on mecholyl bromide, 0.2 Gm. twice a day, mineral oil, 15 c.c. every night, and a normal saline enema two hours after breakfast. In two weeks the mineral oil was discontinued. After another two weeks it became necessary to resort again to its use.

After three months this infant was having two to three stools every day. The treatment continued the same, but enemas were always necessary to start the stool. After nine months of treatment the results were not considered sufficiently satisfactory, and the child was referred to a clinic for surgery. A "double-barrel" colostomy was done and the patient discharged. He was returned two months later to have the colostomy closed. He was brought back six months later with the same distended abdomen and the same difficulty with constipation and large stools. He was readmitted to the hospital and in five days was stabilized on mecholyl bromide, 0.1 Gm. once a day, mineral oil, 15 c.c. every night, and a glycerine suppository two hours after breakfast. After one month the mecholyl was discontinued and one month later the glycerine suppositories were discontinued. The patient now has two or three stools a day, and the mother gives mineral oil only if one of the stools seems to be harder than normal. He has had two or three stools a day for the past nine months.

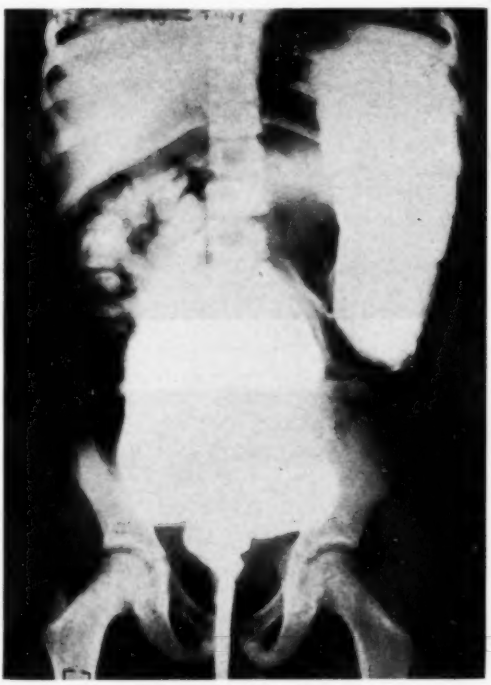

Fig. 3. (Patient A. J.)

K. N., a 19-month-old girl was first seen June 13, 1944, with a history of constipation and large stools dating from birth. This infant was born with an imperforate anus. The attending surgeon made a stab wound at the site of the anal dimple which resulted in a fairly satisfactory anus. On examination this patient had a prominent abdomen which contained a large mass of impacted feces. The anal sphincter was tight. The x-ray showed the size of the dilated colon (Fig. 5). She was placed in the hospital for twelve days where she was stabilized on mecholyl bromide, .05 Gm. once a day, mineral oil, 15 c.c. every night, and an enema two hours after breakfast. Following discharge from the hospital there was one fecal impaction which was removed with an enema. Three months after discharge the mecholyl bromide was discontinued, and the patient continued to have a stool every day. Eight months after discharge the enemas were discontinued entirely, and the patient has continued to have a daily stool with mineral oil.

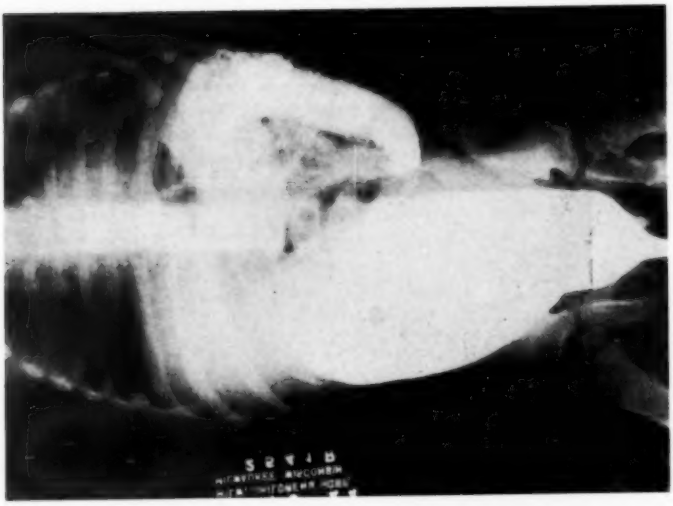

Fig. 5. (Patient K. N.)

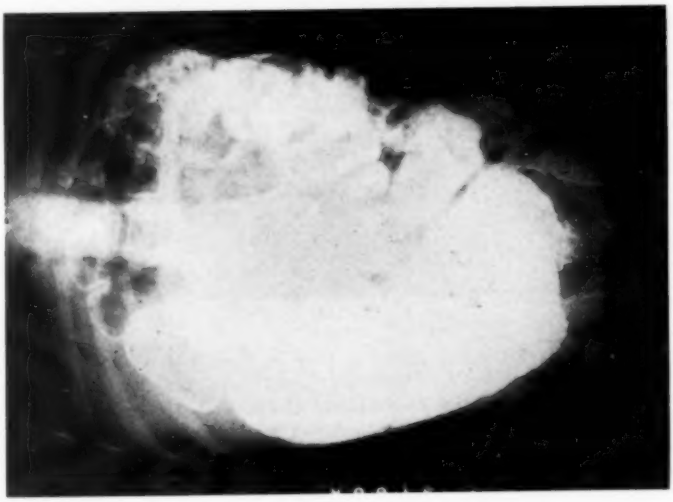

Fig. 4. (Patient R. C.)

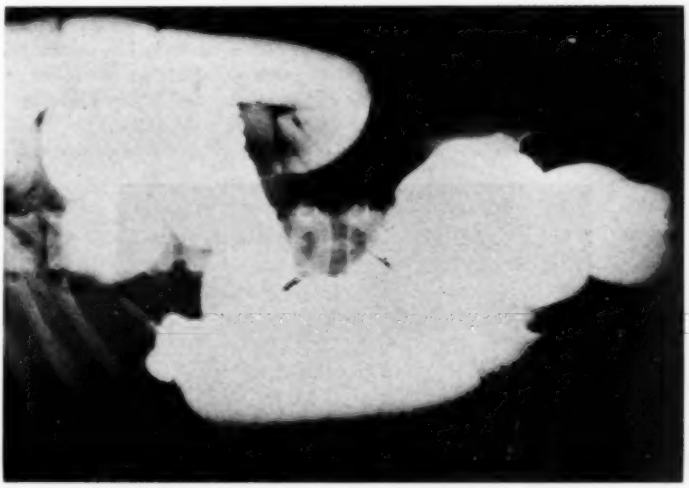

Fig. 7. (Patient K. D.)

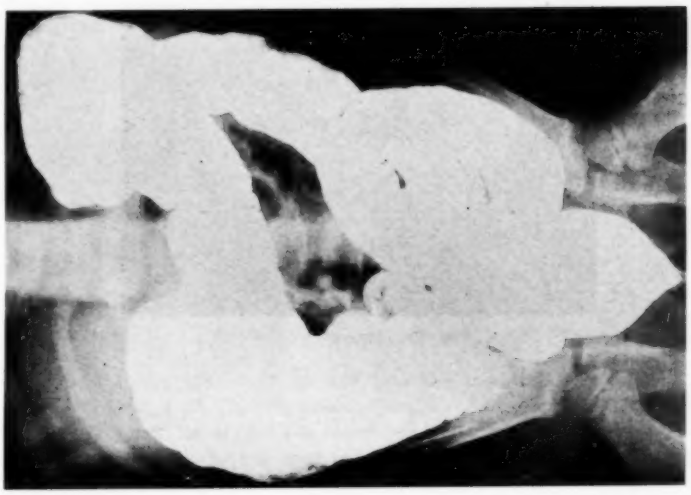

Fig. 6. (Patient G. S.)

G. S., a 5-year-old boy, was first seen Dec. 27, 1944. This boy and his mother gave histories of constipation since birth. They both found it necessary to use cathartics and often repeated enemas to empty the bowels. Examination revealed a prominent, tympanitic abdomen filled with loops of large dilated colon. The rectum was full of impacted feces. The anal sphincter was tight, and the hemorrhoidal veins were dilated. X-ray after barium enema showed the large atonic colon (Fig. 6). The child was hospitalized for six days during which time he was stabilized on mecholyl bromide, 0.2 Gm. before breakfast, an enema two hours later, and mineral oil, 15 c.c. every night. For two weeks the child had two stools every day and the mineral oil was reduced to 5 c.c. every night. After another two weeks the mineral oil was discontinued, and the mecholyl was reduced to 0.1 Gm. once a day. For the next four months the boy had one stool once a day. He is still receiving the same medication.

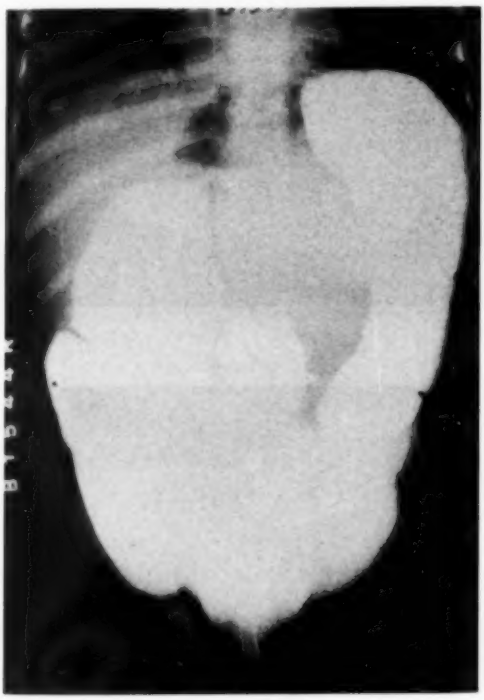

Fig. 8. (Patient K. B.)

K. D., a 6-year-old girl, was first seen Feb. 13, 1945. She gave a history of chronic constipation and large stools since she was 6 weeks of age. At 4 years of age she had a "double-barrel" colostomy done which was closed one year later. The constipation and the large stools had continued the same. There had been increasing vomiting since the closure of the colostomy ten months before my examination. She had severe cramps. Examination revealed a thin, poorly nourished child who weighed 39 pounds and measured 43¾ inches. Her blood count was hemoglobin 78 per cent; erythrocytes 3,950,000; leucocytes, 9,200; neutrophiles, 41 per cent; small lymphocytes, 46; large lymphocytes, 9; large monocytes, 3; eosinophiles, 1. X-ray after the barium enema showed the large, distended colon and sigmoid (Fig. 7). Mecholyl was started and increased to 0.2 Gm. daily. Mineral oil, 15 c.c., was given every night, and an enema was given two hours after breakfast. This treatment did not

sufficiently relieve the distention and the child continued to vomit, at times fecal material. She was given Syntropan,* 0.05 Gm. fifteen minutes before each meal. This gradually revealed what was apparently an obstruction at the site of the intestinal anastomosis, and the vomiting ceased entirely. The child had no more abdominal cramps. She is now having three or four stools a day, as large as before, passed without difficulty.

K. B., a 13-month-old boy, was first seen March 6, 1945. He gave a history of constipation since birth. The stool was said to be very large. It was difficult, and sometimes impossible, for the child to pass the fecal mass. Enemas and mineral oil were necessary. X-ray after barium enema showed the size of the dilated colon (Fig. 8). This boy was hospitalized for twenty days and was discharged on mecholyl bromide, 0.1 Gm. before breakfast; zymenol, 15 c.c. every night; and an enema two hours after breakfast. He now has normal stools daily.

SUMMARY

Eight cases of congenital megacolon are presented. Chronic constipation or obstipation from birth was the chief complaint in most of these children. The ages ranged from 14 months to 9½ years. Two patients had had colostomy operations with no relief and one child had undergone lumbar sympathectomy without relief. All of the patients except one responded very satisfactorily to treatment with mecholyl bromide. This patient, K. D., was given complete relief of symptoms with syntropan.[5] With such satisfactory results following safe and inexpensive medical treatment there is no justification for hazardous surgical intervention which offers no promise of relief.

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*Phosphate salt of 3-diethylamino-2, 2-dimethylpropanol tropic acid ester.

SUBCUTANEOUS ADMINISTRATION OF SODIUM SULFADIAZINE

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THE subcutaneous administration of the sodium salt of sulfadiazine or other sulfonamides has not been given the attention which its importance deserves.

The common methods of administering the sulfonamides are the oral and intravenous routes. However, in certain types of patients both methods are impracticable and it seems desirable to utilize the subcutaneous route.

Some of the more common types of patients in which the subcutaneous method of administration seems to have great advantages are the following: (1) Patients, especially children, who refuse oral medication, vomit incessantly, are unconscious or in convulsions. (2) Those whose gastrointestinal tract should be at rest for surgical reasons. (3) All acutely ill patients in whom we desire to reach rapidly and maintain a high blood concentration of sulfonamide. So far, the usual way of administration to those patients is venoclysis and this procedure, aside from requiring special skill in infants and children, is not always satisfactory. Although the peak of the blood level is reached very rapidly, it is necessary to repeat the injections at frequent intervals to maintain a good concentration.[1, 2] This requires a continuous intravenous drip and it is well known to those who deal with children how difficult it is at times to establish a continuous venoclysis and to maintain it for several days.

Searching the literature, we have found that the sodium salt of sulfadiazine has been used subcutaneously in high dilutions of about one-half of 1 per cent at several hospitals[3, 4, 5] and that only a few hospitals used the higher concentration of 5 per cent.[3, 6, 7]

We have used for this study the commercially supplied ampules of 10 c.c. of a 25 per cent solution of sodium sulfadiazine. These ampules are furnished with printed instructions, indicating that the contents should be diluted five times with distilled water and is to be used *intravenously only*. The warnings read: "Not to be administered subcutaneously, intramuscularly or interspinally . . . to avoid leakage into subcutaneous tissue." It is the high alkalinity of the substance (the pH of the prepared solution is about 9) which has caused fear of local reactions.

The dosage in our series was based on the weight of the patient. We have given 1 grain per pound of body weight as a daily dose and divided this amount by 2, to be given at twelve-hour intervals (Charts II, III, and IV). In the beginning of our study, we tried the eight-hour interval, (Chart I) but found that the blood concentration does not fully return to a sufficiently low level before the time of the next injection and that this accumulation causes excessively high blood levels in twenty-four to forty-eight hours.

Before the usefulness of this method can be established, several questions have to be answered and for this purpose a series of patients has been treated in the manner which we have described and have been observed during their stay in the hospital.

From the Children's Memorial Hospital, Chicago.

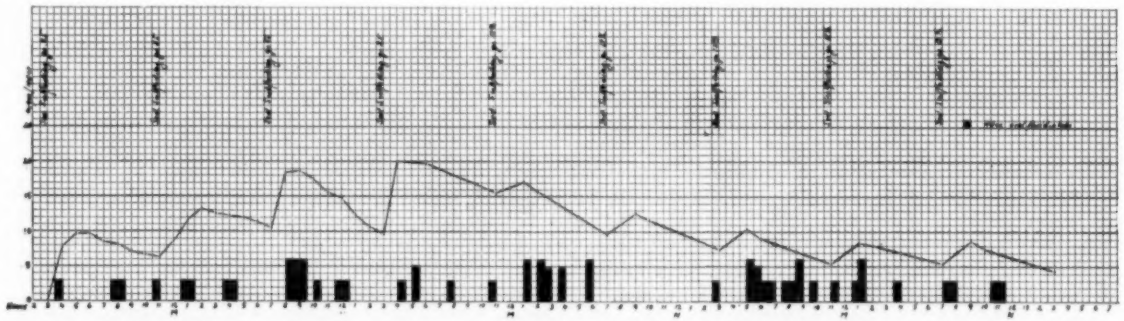

Chart I.—W. B., aged 9½ years; weight, 68 pounds; temperature, 103.4 to 98.6° F.; suppurative otitis media, mastoiditis.

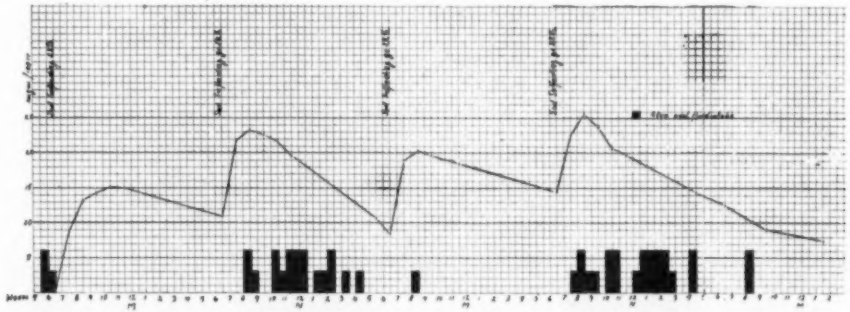

Chart II.—C. C., aged 6 years; weight, 47½ pounds; temperature, 102 to 98.6° F., pharyngitis, mesenteric lymphadenitis.

1. Absence of local irritation or reaction.

In spite of the warning instructions of the accompanying literature, we have never found any untoward local reaction. We chose the thighs as the sight of injection and alternated the sides. There was no reddening, swelling, or induration and only occasionally the slightest amount of tenderness occurred as frequently noticed after any type of subcutaneous injection. In

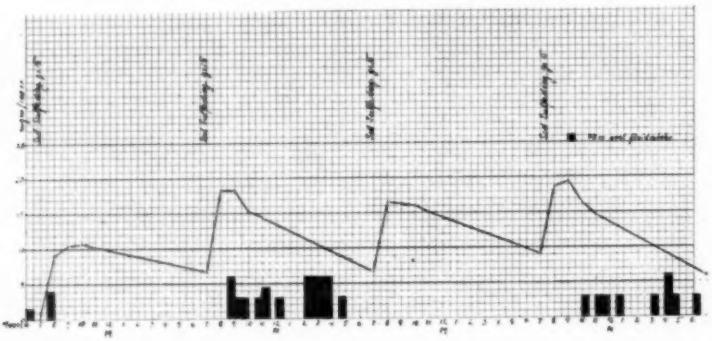

Chart III.—D. W., aged 4½ years; weight, 33 pounds; temperature, 103.8 to 98.6° F., suppurative otitis media.

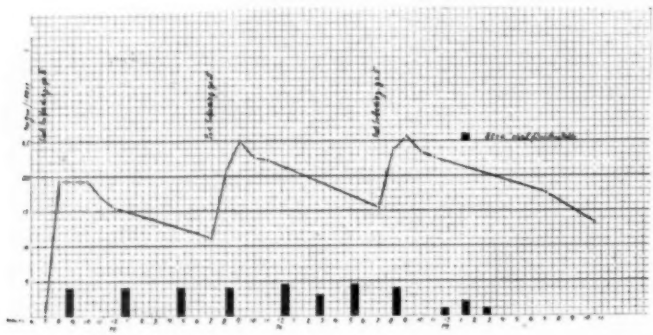

Chart IV.—M. D., aged 2½ mo.; weight, 8 pounds, 9 ounces; temperature, 106.2 to 101° F.; pneumonia (type 23).

none of our patients was a systemic toxic reaction noted. Crystals were noticed in the urine frequently and in some cases red blood cells were reported. This last finding indicated to us in most cases the necessity to discontinue the sulfadiazine administration. However, by increasing the fluid intake, crystals in the urine may be reduced in number and hematuria prevented in most cases.

2. The concentration of the applied solution has to be strong enough not to require large amounts of fluid for the individual injection.

A 5 per cent solution furnishes 1 Gm. or 15 grains per 20 c.c. Our dosage, being 1 grain per pound of body weight in twenty-four hours, made, even in the largest children in our series, not more than 90 grains in twenty-four hours. Each injection contained 45 grains or 60 c.c. of the solution, an amount which

can easily be injected subcutaneously in the thigh without discomfort to the patient.

3. The matter of early and high blood concentrations and maintenance of them is of greatest importance.

We collected blood samples at frequent intervals to determine the highest and the lowest blood concentration of the sulfadiazine. The macroscopic and microscopic method described by Bratton and Marshall was used throughout.[8] This gave us also the opportunity to study the course of elimination as influenced by the fluid intake. The detailed answer to these questions is given in the sample charts, which have been selected among a larger number of almost identical graphs. A satisfactory blood concentration was reached in one hour or less. The maximum concentration was obtained in two to three hours, after which time the level began to decline gradually. After twelve hours, the time of the next injection, the blood concentration was still satisfactory from a therapeutic viewpoint. Increased fluid intake speeded the output of the drug considerably as seen by the steep decline of the graphic line of blood concentrations (Charts II and III); one could, therefore, feel safe in being able to lower the level at any desired moment, by increasing the fluid intake.

4. The fourth question to be answered was the clinical efficacy.

Judging from the clinical findings, the reduction of the temperature and the decrease in the number of the white blood cells, the recovery of our patients took place in the manner that would be expected by intensive sulfonamide therapy.

DISCUSSION OF CHARTS

Chart I represents the reports of one of the patients treated by injections at eight-hour intervals. The total dosage for the twenty-four-hour period was slightly above 1 grain per pound of body weight. It is evident from the graph that with each injection the blood concentration rose for the first thirty-two hours, at which time the dose was cut in half; this resulted in a rather even level between 5 and 10 mg. of sodium sulfadiazine per 100 c.c. of blood. The hourly blood level determinations on these patients during the first twenty-four hours show the regularity with which the blood level was maintained. Its peak was reached each time during the second and third hour after injection. The fall of the blood concentration depended upon the fluid intake. During the first, second, and fourth eight-hour periods the level fell 3.5, 2.7, and 4.7 mg., the fluid intake was 480, 480, and 500 c.c., respectively. During the third and fifth period the fluid intake was 1,080 c.c. in both periods and the fall of the blood level 8.9 and 7.5 mg., respectively.

Charts II and III represent studies in which the drug was given at twelve-hour intervals in doses of one grain per pound of body weight in twenty-four hours, divided in two doses. These charts show the persistency of the blood levels and are very instructive as to the influence of the fluid intake on the blood sulfadiazine concentration. Note in Chart II the two night periods, during which time fluids were withheld. The blood level fall was 4.2 and 5.6 mg. During the days the child received 2,160 and 2,520 c.c. of fluid and the blood level fall was 12.6 and 13.2 mg., respectively.

Chart IV is presented to demonstrate the administration to a very acutely ill small infant. The daily dose was above 1 grain per pound and this fact and the state of dehydration of the child resulted in a slightly higher level than on the other charts. The peak of the first twelve-hour period was reached after the first hour for the same reason. Essentially and for all practical purposes the curve is identical with those of the older children.

COMMENTS

On the basis of our experience with our series treated by subcutaneous administration of sodium sulfadiazine, we have found it a very satisfactory method for the treatment of the acutely ill child. The subcutaneous method is not only perfectly suitable to replace the intravenous route but offers many conveniences for those patients who otherwise would be struggling with oral medication.

At this point the suggestion might be made to use sodium sulfadiazine subcutaneously in the child who is being treated at home. A certain number of patients have to be hospitalized mainly for the reason that oral medication has become impossible, due to the lack of cooperation from the parents or child or due to vomiting, and other means of sulfonamide therapy (e.g. intravenous) are impracticable in the home. It would be perfectly possible to administer the drug subcutaneously at the home and to repeat it once at a second visit in twelve hours. This time of rest for the gastrointestinal tract and the effective action of the sulfonamide should improve the condition of the patient enough to permit oral medication from there on. Hospitalization could thus be avoided, which certainly would be desirable at the present time of the shortage of hosptial beds and nursing facilities.

SUMMARY

The subcutaneous administration of the sodium salt of sulfadiazine has been studied and the effectiveness of this method was evaluated from a clinical and laboratory viewpoint.

It is thought that this method offers several advantages over the intravenous route of administration and in some instances over the oral route.

It may be used conveniently in the home as well as in the hospital in selected cases.

It is a pleasure to acknowledge the helpful assistance of Miss Rebecca Berg for doing the blood counts and urine analyses.

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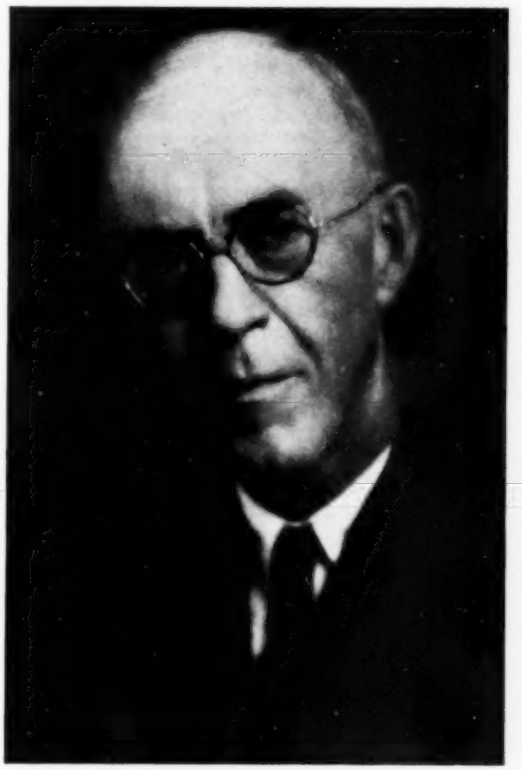
American Academy of Pediatrics

THOMAS BENTON COOLEY

1871-1945

THOMAS BENTON COOLEY, president of the Academy, 1934 to 1935, and member of the Editorial Board of THE JOURNAL OF PEDIATRICS, died in a hospital in Bangor, Maine, near his summer home in Sorrento, Maine, October 13, 1945. Dr. Cooley was born in Ann Arbor, Michigan, June 23, 1871, the son of Thomas McIntyre Cooley, a distinguished educator on the faculty of the law school of the University of Michigan. He received his A.B.



Thomas Benton Cooley
1871-1945

degree from the University of Michigan in 1891 and his M.D. degree four years later. In 1940 his alma mater conferred the degree of D.Sc. upon him. Following graduation he interned at the Boston City Hospital for two years and then returned to teach in the Medical School at Michigan. The year 1900 to 1901 was spent abroad in graduate work, from which he returned for a year as resident physician at the Boston City Hospital. From 1903 to

1905 he was assistant professor of hygiene at the University of Michigan. In 1905 he went to Detroit to specialize in pediatrics, where he lived the remainder of his life. He was chief of the pediatric service and chairman of the staff at the Children's Hospital of Michigan from 1921 to 1941, and professor of pediatrics at Wayne University from 1936 to 1941. He was a member of many medical and scientific societies in whose work he took an active part. He served as president of the American Academy of Pediatrics, 1934 to 1935, and president of the American Pediatric Society in 1941. During World War I he was assistant chief of the Children's Bureau of the American Red Cross in France and was awarded the Cross of the Legion of Honor by the French government in 1924.

In 1903, he married Abigail Hubbard, who died earlier this summer at Sorrento. He is survived by a daughter, Emily Holland Cooley, and his son, a lawyer, Thomas McIntyre Cooley.

Such is a brief, factual, biographic record of a man who was loved and respected by everyone, and who by his scientific attainments made an outstanding place for himself in pediatrics and American medicine. He made many contributions to medicine and medical literature. His chief interest was in the blood and in the anemias of childhood. Erythroblastic anemia is commonly known as "Cooley's anemia"—a term he disliked. He contributed chapters to Abt's and to Brennemann's Systems and at the time of his death he was writing a book on the blood. In recent years he was deeply interested in disease from a hereditary standpoint. His contributions to medical literature were outstanding in their scholarly quality.

In a sense Dr. Cooley lived a generation too early. He was primarily interested in scientific research, hospital work, and teaching. He held to these with the highest idealism, at a time when there were no pediatric clinics such as exist today in America to foster such development and to give opportunity to men with a type of inquiring mind such as he possessed. His work was accomplished by hard personal struggles without environmental aid. In addition to his scientific accomplishments, he was one of the pioneers in child health work and did much in his community to improve medical conditions for children.

There was another side to Tom Cooley which those of us who have known him for thirty years or more will always remember—his broad interests and his companionability. He loved fishing and golf and he had an intimate knowledge of and love for art and music and literature. He was honest and loyal in his friendships and straightforward in his thinking and relations to others. To the younger group of pediatricians who knew him only in recent years, when, despite ill health, he accomplished so much, he was a respected and revered senior friend.

In the death of Tom Cooley we have lost one of the most distinguished pediatricians of our time.

B. S. V.

Academy News

The annual meeting of the American Academy of Pediatrics will be held at the Book-Cadillac Hotel in Detroit, January 15 to 18, 1946. This will be the first meeting in over a year due to war travel restrictions. Many important matters will come up for full discussion by the Academy.

Arrangements have been made to hold a meeting of Region II on Wednesday morning, November 14, 1945, at the time of the meeting of the Southern Medical Association in Cincinnati.

A meeting of Region I will be held at the Pennsylvania Hotel in New York, April 2, 3, and 4, 1946.

Arrangements are being made for a meeting of Region III in Chicago early in May, 1946.

The deaths of the following Fellows have been reported to the JOURNAL:

Dr. Charles G. Kerley, New York, N. Y., September 7
Dr. Joseph C. G. Regan, Brooklyn, N. Y., August 15

The following are the recommendations of the nominating committee of the American Academy of Pediatrics:

For Vice-President (President-elect)

Dr. Lee Forrest Hill
Des Moines, Iowa

For Chairman of Region III

Dr. George F. Munns
Winnetka, Ill.

Respectfully submitted,

DR. J. A. HENSKE, Chairman
DR. HUGH CHAPLIN
DR. HUGHES KENNEDY, JR.
DR. OSCAR REISS

News and Notes

The journal, *The Nervous Child*, has been bought by its founder and Editor-in-Chief, Dr. Ernest Harms, from its previous owner, Grune & Stratton, Inc., Medical Publishers, of New York City. *The Nervous Child* will be produced from now on by a new publishing house, Child Care Publications, 30 West 58th Street, New York 19, N. Y., which has been created for this purpose. The same publishing house will start to issue during 1946 another periodical entitled, *The Journal of Child Psychiatry*, devoted to unsolicited contributions in the field of mental disease in children.

ANNOUNCEMENT OF CERTIFICATION IN ALLERGY BY THE AMERICAN BOARD OF PEDIATRICS, INC.

The American Board of Pediatrics, Inc., at its last meeting in New York City, took final action establishing certification in allergy as a subspecialty of pediatrics.

Certification in pediatrics by the American Board of Pediatrics, is a prerequisite for such certification in allergy. Those who are already diplomates of the Pediatric Board and who wish to be certified in allergy must make formal application to the Secretary of the American Board of Pediatrics, Dr. C. A. Aldrich, 115½ First Avenue, S. W., Rochester, Minn. Those who are not yet certified in pediatrics and who desire certification in allergy as well should indicate this in their application to the Board of Pediatrics as examination in both subjects may be held at the same time.

The application fee for certification in allergy will be $25, in addition to the application fee for pediatric certification.

An Advisory Committee on Allergy has been appointed to act with the Board of Pediatrics in all matters pertaining to the selection and examination of applicants for subspecialty certification. This Committee is identical with the Advisory Committee on Allergy of the American Board of Internal Medicine. The present members of this Committee are:

Harry L. Alexander, M.D.
Robert A. Cooke, M.D.
Leslie N. Gay, M.D.
Harry L. Huber, M.D.
George Piness, M.D.
Francis M. Rackemann, M.D.

In December of this year, Dr. Oscar M. Schloss will be appointed as the pediatric member of this Committee to take the place of the retiring member.

The Advisory Committee on Allergy has already outlined the requirements for applicants who desire examination in the subspecialty of allergy as follows:

1. Two years, full time, in a satisfactory allergy clinic and its hospital (including training in both allergy and pediatrics), or

2. One year, full time, in the allergy clinic and its hospital, and two additional years of full attendance on such an allergy clinic and its activities, or

3. Five years, full attendance, on such an allergy clinic and its activities, or

4. Special training under qualified preceptors, solely or in combination with aforementioned types of training, and such other training as might be felt adequate to prepare an individual for the practice of allergy.

It is the further opinion of the Committee that clinics for such training should fulfill the following qualifications:

1. They should be in hospitals that have been accepted by the Council on Medical Education and Hospitals and by the American Board of Pediatrics for training and certification in pediatrics and for residencies in pediatrics or medicine.

2. The Director of the Allergy Clinic shall be a diplomate certified in allergy by the American Board of Internal Medicine or American Board of Pediatrics.

When accepted, the diplomate will receive from the American Board of Pediatrics a certificate in allergy and will be listed as a specialist in allergy in the official directory of the Advisory Board for Medical Specialties.

Prospective applicants for certification in the subspecialty of allergy may apply to the Secretary of the American Board of Pediatrics, Dr. C. A. Aldrich, 115½ First Avenue, S. W., Rochester, Minn., any time after Nov. 1, 1945.

The Pediatrician and the War

Promotions of the following Fellows of the Academy have been reported to the JOURNAL:

Army

Captain Benjamin M. Kagan, Richmond, Va., to Major

Major Aims C. McGuinness, Philadelphia, Pa , to Lieutenant Colonel

Captain Hugh C. Thompson, Tucson, Ariz., to Major

Navy

Lieutenant (sg) W. S. Nolting, Detroit, Mich., to Lieutenant Commander

Lieutenant Commander L. B. Outlar, Wharton, Texas, to Commander

The following Fellows have been released from service:

Dr. Emanuel B. Brandes, Houston, Texas
Dr. Philip C. Elliott, Nashville, Tenn.
Dr. Dennis H. Kelly, Des Moines, Iowa
Dr. Bruce A. Knickerbocker, Dallas, Texas
Dr. Herman B. Lander, Chicago, Ill.
Dr. Douglas D. Martin, Tampa, Florida
Dr. Harry Medovy, Winnepeg, Canada
Dr. Norman Survis, New Rochelle, N. Y.
Dr. Gustav F. Weinfeld, Highland Park, Ill.
Dr. Norman T. Welford, LaGrange, Ill.

The Social Aspects of Medicine

COMMENTS ON THE MARYLAND PLAN FOR MEDICAL CARE AS OUTLINED BY DR. DEAN ROBERTS IN THE OCTOBER ISSUE OF THE JOURNAL OF PEDIATRICS

The program for medical care of the medically indigent in the State of Maryland, as outlined by Dr. Dean Roberts, which appeared in this column last month, is of more than usual importance for several reasons. First, the plan is not merely up for consideration like most others but it is in actual operation. Second, although it was started by the physicians of the state themselves, it was worked out in combination with dentists, nurses, hospital superintendents, representatives from the City and State Health and Welfare Departments, pharmacists, labor organizations, and the lay public. The initiative in a program for medical care ought always to come from the physicians themselves. It is a source of great satisfaction that the Maryland program had this kind of birth. But it is of more importance that the various agencies concerned with the many aspects of medical care were called in as active participants and that labor groups and the general public were given a voice. A great mistake which large bodies of physicians are making at the present time in considering improvements in medical care, a mistake which has its origin in that most dangerous of all states of mind, egotism and its attendant blindness, is the assumption that the medical profession understands the needs of the lay public so much better than the lay public does, that what the public thinks or wants is irrelevant and of negligible significance. The blindness is shown in the inability to see that the lay public, and not the medical profession, really is the one vitally interested and concerned and that it is the one vested with the power of decision and that, if the physicians do not come forward with a satisfying program, the public will develop a program of its own over the heads of the physicians. This is the significance of Wagner-Murray-Dingell Bill. The bill is the attempt on the part of legislators to express what they think the public wants. The bill is not coming from the legislators; it is coming from the public through the legislators. It is a great fire on the horizon, the portent of which only the psychically blind among us fail to see. Accordingly it is most important that the program for the State of Maryland had its origin in so representative a sampling of the people that no voice could be raised against it from any quarter.

The program has two other splendid features, one not mentioned in Dr. Robert's summary. The latter is that a full-time consultant in Obstetrics has been provided who will devote his entire time to touring the State and County clinics to give his advice and who will also be available in emergencies for case consultations. He is a member of the American Board of Obstetrics and Gynecology and is on a full-time salary paid through the state. It is anticipated that before long a pediatric consultant will be added. The other splendid feature lies in the appointment in each county of a county advisory committee on medical care having a wide representation. Three members are named by the county medical society; one member is named by the county dental society; another is appointed by the Maryland Pharmaceutical Association; the others are: the executive of the County Welfare Board, the Chairman of the Board of County Commissioners and the County Health Officer who serves as chairman. The advisory committee in the county is empowered to add to its number the superintendent of schools, a Negro representative, a nurse, a representative from the local hospital administration, and a representative in the field of public health. This advisory committee sits on difficult problems which arise locally and endeavors to guide smoothly the work of the physicians. It does not have the power to make final decisions; the latter must be passed by the Council on Medical Care for the State. The important point is that a mechanism has been established in each county to meet emergencies and difficulties and to advise in regard to policies at the level at which the problems arise.

The program advocates and involves "state medicine." The State of Maryland furnishes money and the payment of the doctor comes through the State Board of Health according to a fixed fee system determined by the State Health Department with the advice of professional groups.

The Maryland plan illustrates what a bogey has been made out of the expression "state medicine." How can a system of medical care for the indigent be organized except through the state and how can the physicians be paid for their services to the medically indigent except through the state? Certainly no one of us can object if as the result of the solicitude of the body politic sick people receive medical care when they were unable to receive it before or physicians receive payment when before their work was free. When confronted with a new idea or proposal the duty of us pediatricians is dispassionately to consider whether it is good or bad and to accept the good ideas and proposals no matter what their origin and to try to prevent the development of the bad.

Of course we in Maryland hope that the program is just a beginning, because $200,000 is a woefully inadequate sum of money for the care of the medically indigent and a single consultant in obstetrics is woefully inadequate also. The program is to be regarded as a very small first step in meeting the medical needs of the community but it is certainly an intelligent one in the right direction. There is no provision in the Maryland program to furnish adequate medical service in the rural communities where doctors are unavailable even to those who can pay. There is no provision for the creation of hospital facilities or adequate provision for making laboratory or x-ray facilities available where such are lacking.

The Maryland Medical Program raises a vital point, namely, the definition of "medically indigent." From the patient's standpoint the term means the man able to pay for other essential needs but unable to pay his doctor; to the doctor it means solely the man who cannot pay his bill. The decision whether or not a given individual is medically indigent will cause many a headache. But if the program were actually extended so as to include all the medically indigent, charity work by the doctor would cease.

E. A. PARK.

Comment

THE ACADEMY STUDY ON CHILD HEALTH SERVICES

The study of child health services which was inaugurated by the Academy at its meeting in St. Louis in November, 1944, is developing into the most important and extensive project which the Academy has undertaken. A full meeting of the Committee was held in Chicago on October 20, to discuss current work and future plans. The minutes of this meeting will be published in the next issue of the JOURNAL, in order that the members of the Academy may be prepared for the discussion of the project which has been given a prominent place on the agenda of the Academy meeting in Detroit next January.

The project is unique in that it is a study by doctors of the situation in their own field of work, of the medical care received by and available to children, of existing facilities for medical care, and the education and training of physicians giving the care. It is not a survey by a lay group, a foundation, or a department of the government. Nevertheless all of these groups are most interested in the project and are helping in many ways the group of physicians who are directing and making the study. The scope and magnitude of the study has been steadily increasing as the general purposes have been thought out and developed along detailed lines. It must be emphasized that the study is in no way connected with the many plans which have been proposed for medical care, nor related to any of the federal proposals for medical care such as the Pepper or Wagner-Murray-Dingell bills, which are the center of so much present-day controversy. It is the viewpoint of the committee in charge, and this was the thought back of the Academy action to undertake the study, that the important thing is to find out on a nation-wide basis what medical care American children receive and what facilities for medical care are available. Only on such a foundation can sound and intelligent plans for the future be built.

At the present time a sample study is being made in North Carolina, which is being used as a "pilot state," to gain experience before extending the study throughout the nation. The project met the approval of the North Carolina Pediatric Society at its meeting at Roaring Gap on September 2. Dr. Alfred H. London, Jr., State Academy Chairman of North Carolina, is heading the work with the assistance of members from the central office of the committee which has been established at the Children's Hospital in Washington. Dr. Wall, President of the Academy, and Dr. Warren Sisson, Chairman of the Study Committe, have given unstintingly of their time in developing the project on a sound basis. It will call not only for cooperation, but also for active work on the part of practically every member of the Academy if the study is to be carried out successfully along the lines which are being developed.

Again the pediatricians are demonstrating group leadership in the field of medicine.